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Exhibit 2 - Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
NEW CASTLE COUNTY, DELAWARE

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of New Castle County, Delaware, and aids in the admini- stration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses in this study represent a revision of the original analyses. The updated version was prepared by the Philadelphia District of the U. S. Army Corps of Engineers for the Federal Emergency Management (FEMA), under Inter-Agency Agreement No. EMW-E-0941, Project Order No. 4. This work was completed in November 1984.

1.3 Coordination

On May 21, 1982, study methods were agreed upon and sources of basic data were identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA, New Castle County, and the U. S. Army Corps of Engineers (COE). Subsequently, a community map was supplied to the COE by community officials. On October 24, 1985, the results of the study were reviewed at a final CCO meeting held with representatives of FEMA, the county, and the COE.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of New Castle County, Delaware. The Cities of Newark, New Castle, Wilmington, and Delaware City and the Towns of Elsmere, Newport, and Middletown are not included in this study. The area of study is shown on the Vicinity Map (Figure 1).

The Christina River from the CONRAIL crossing to the upstream county boundary, Christina Creek, East Branch, West Branch, Belltown Run, and Muddy Run were studied by detailed methods in the original Flood Insurance Study for New Castle County and have been included in this revised study (Reference 1).

The following streams were studied by detailed methods as part of the revised study: the remaining portion of the Christina River within the county; Red Clay Creek from its confluence with White Clay Creek to the upstream county boundary; White Clay Creek from its confluence with the Christina River to a point approximately 0.57 mile upstream of Chambers Rock Road; Tributary to White Clay Creek from its confluence with White Clay Creek to State Route 4; Mill Creek from its confluence with White Clay Creek to the upstream county boundary; Pike Creek from its confluence with White Clay Creek to State Route 72; Little Mill Creek from its confluence with the Christina River to State Route 141; Chestnut Run from its confluence with Little Mill Creek to Faulkland Road; and Brandywine Creek for a distance of 0.15 mile at the Delaware-Pennsylvania state boundary and for a distance of 1.42 miles at the New Castle County-City of Wilmington border.

Tidal flooding from the Delaware River (also affecting the downstream portions of the Christina River and the Smyrna River) was also studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions of the following flooding sources were studied by approximate methods: Brandywine Creek; Hoopes Reservoir; Matson Run; Purkey Run; Shellpot Creek; South Branch; Naaman Creek; Belltown Run; Red Lion Creek; Dragon Creek; Doll Run; Pigeon Run; Muddy Run; Lums Pond; Back Creek; Chesapeake and Delaware Canal; Scott Run; Augustine Creek; Silver Lake; Noxontown Pond; the Appoquinimink River; Sandy Branch; Shallcross Lake; Drawers Creek; Silver Run; Great Bohemia Creek; Herring Branch; Blackbird Creek; Barlow Branch; Mangmans Run; Beaver Branch; Sawmill Branch; Dogwood Branch; Cypress Branch; Paw Paw Branch; Long

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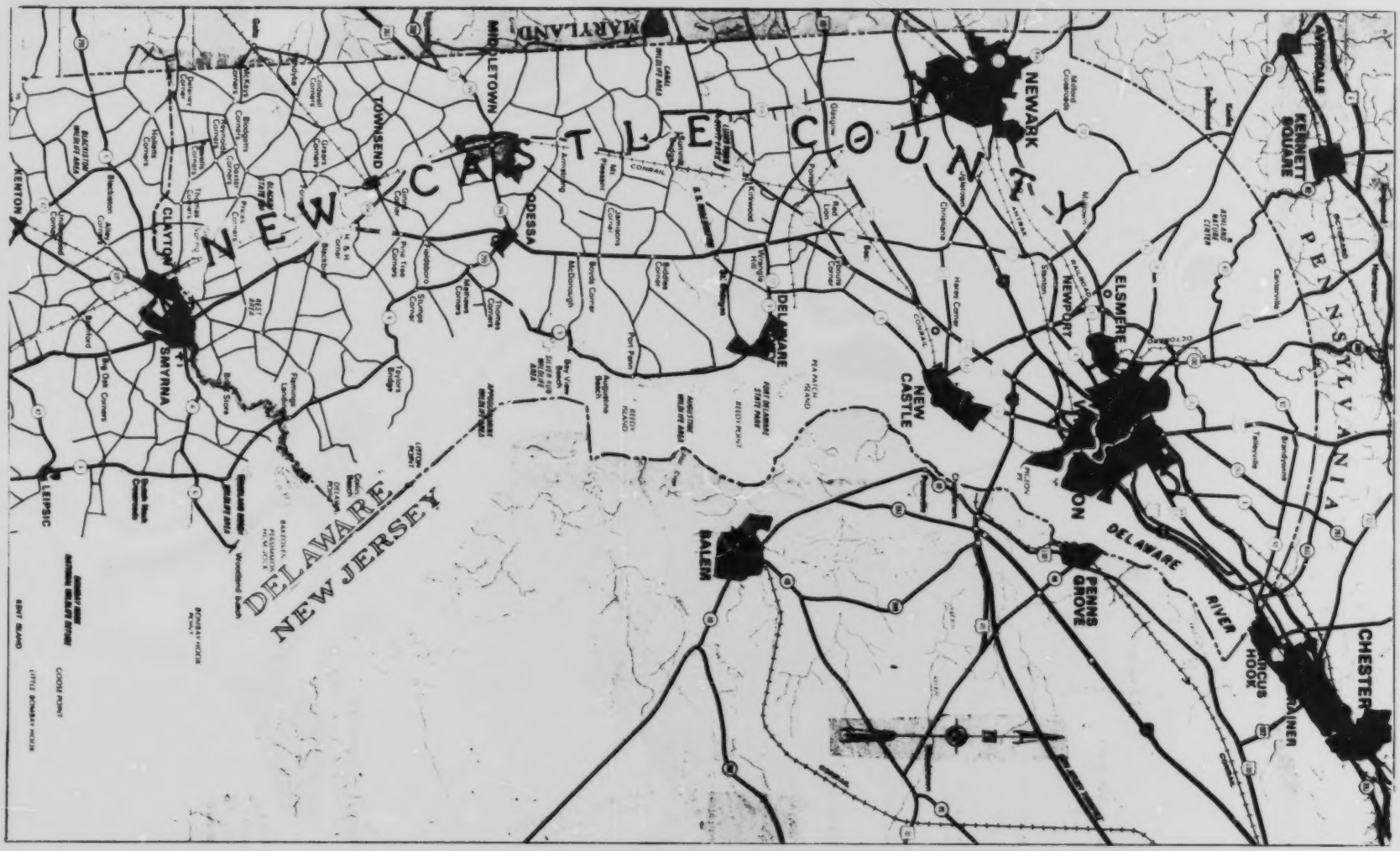

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

SCALE IN MILES

0 5 10

VICINITY MAP

Creek; Corks Point Ditch; Duck Creek; Duck Creek Pond; and Green Spring Branch. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and New Castle County.

2.2 Community Description

New Castle County, the northernmost of the three counties in Delaware, is situated in the heart of the complex of metropolitan areas that has come to be known as the megalopolis corridor. It is bordered by the Townships of London Britain, New Garden, Concord, Bethel, Kennett, Upper Chichester, and Lower Chichester and the Borough of Marcus Hook, Pennsylvania, to the north, the Townships of Lower Alloways Creek, Oldsman, Elsinboro, Pennsville, Greenwich, Fairfield, and Upper Penns Neck and the Borough of Penns Grove, New Jersey, to the east, the Town of Clayton, the Town of Smyrna, and Kent County, Delaware, to the south, and Cecil and Kent Counties, Maryland, to the west. New Castle County has a total land area of 435 square miles. The population of the county was 398,115 in 1980 (Reference 2). Nearly 67 percent of the population of the state is located in New Castle County.

The Delaware River, which flows south, forms the boundary between Delaware and New Jersey. The flood plain of the river is tidal within New Castle County and is characterized by marshes with little development near its banks south of the confluence of the Christina River.

The Christina River basin is located in the extreme southeastern corner of Pennsylvania and the northern part of Delaware. The river flows in a semicircular path from its headwaters to its confluence with the Delaware River, a distance of approximately 35 miles. The Christina River is tidal from its confluence upstream to Smalleys Pond. The tidal portion is generally characterized by marshes located adjacent to the channel on both banks. Tributaries to the Christina River include White Clay Creek, Red Clay Creek, Little Mill Creek, Christina Creek, East Branch, West Branch, Muddy Run, Belltown Run, and Brandywine Creek.

White Clay Creek, a major tributary of the Christina River, has its headwaters in southeastern Pennsylvania and flows south through New Castle County to its confluence. The stream flows through extremely narrow valleys with steep side slopes to highly developed valleys with a wide, extensive flood plain. Tributaries to White Clay Creek include Red Clay Creek, Pike Creek, Mill Creek, and Tributary to White Clay Creek.

Red Clay Creek, Pike Creek, and Mill Creek all flow southeast to their respective points of confluence with White Clay Creek. The flood plain of Pike Creek is generally characterized by steep stream banks covered

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with brush and trees. Mill Creek also has steep stream banks. Tributary to White Clay Creek flows south to its confluence and has wide, marshy flood plains with some development along its banks.

Little Mill Creek flows southwest and then southeast to its confluence with the Christina River. The flood plain of the stream is characterized by steep stream banks and flood plains. Chestnut Run flows southwest to its confluence with Little Mill Creek. Its flood plain is highly developed with moderate to steep stream banks.

The climate of New Castle County is one of warm summers, when the temperature can rise above 85 degrees Fahrenheit (°F), and cool winters, when the temperature can fall below 20°F. The annual precipitation in the area averages 42 inches and is fairly evenly distributed throughout the year, although a major portion occurs in the late spring and summer.

2.3 Principal Flood Problems

Flood problems currently exist along the Christina River, White Clay Creek, Red Clay Creek, Mill Creek, Pike Creek, Little Mill Creek, Chestnut Run, and other streams in New Castle County. Inadequate drainage facilities in developing population centers have compounded the problem in urban areas.

The lower portion of the Christina River is also subject to tidal flooding from the Delaware River. This may occur along with or in combination with fluvial flooding. The flood of record for the Christina River basin as a whole occurred during Tropical Storm Agnes on June 22-24, 1972. This storm resulted in flooding at many locations in the basin; however, due to the large size of the basin, other more localized storms resulted in greater damage to certain parts of the basin. Therefore, the flood of record for individual areas varies throughout the basin.

White Clay Creek and Red Clay Creek have experienced substantial flooding in the past. Damage has been the result of backed up sewers, flooded roads, and flooded cellars. The Delaware Park Race Track, located along White Clay Creek upstream of the confluence of Red Clay Creek, was damaged in the flood of July 5, 1937. This flood had the highest recorded stage at the U. S. Geological Survey (USGS) gage near Newark, Delaware. High stages on Mill Creek have produced intense flooding at camps in the Hockessin, Delaware, area. On September 12, 1960, Hurricane Donna produced the greatest flood of record on Red Clay Creek at the USGS gaging station at Wooddale, Delaware. This and other floods damaged several industries in Yorklyn, Delaware. Some damage has also occurred along Red Clay Creek in the Stanton, Delaware, area.

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The Wilmington Marine Terminal and other industries near the mouth of the Christina River have been flooded by high tides on the Delaware River. The storm of November 25-26, 1950, produced the worst flooding in this area, with depths of up to 3 feet. Homes along the Christina River in the Newark area have had backyards and basements flooded on several occasions by fluvial floods.

Two major floods have been well documented on Little Mill Creek. The flood of July 8-9, 1952, took place prior to the installation of the USGS gage. The August 9-10, 1967, flood is the flood of record at the gage. It was caused by an intense thunderstorm and damaged primarily residential properties in the Elsmere area.

2.4 Flood Protection Measures

Presently, there are no major flood control measures that would alter flood flows on the streams studied by detailed methods. Residents of New Castle County depend on the usual warnings issued through radio, television, and local newspapers for information concerning possible flood conditions. Flood warnings and predicted flood peaks are issued by the National Oceanic and Atmospheric Administration Flood Forecasting Centers located at Harrisburg, Pennsylvania, and Trenton, New Jersey.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for the flooding sources studied in detail affecting the county.

The hydrologic analysis for the Christina River basin included an evaluation of historic storms and the development of a rainfall-runoff model using the COE HEC-1 computer program (Reference 3). The HEC-1 program was used in conjunction with recorded precipitation data to model historic flood events (Reference 4). Hypothetical rainfall distributions were developed using National Weather Service Technical Paper No. 40 (Reference 5). The rainfall runoff model was then used to determine the peak flow and hydrograph for each frequency event at various index locations.

The log-Pearson Type III method was used to develop discharge-frequency curves from the historic flood records at each gage location in the basin. A standard project storm was derived using criteria developed by the COE (Reference 6).

Final discharge-frequency values were computed from composite analyses of streamflow gage records, the rainfall-runoff model, and the COE Standard Project Flood. Minor adjustments were then made to calibrate the resultant frequency values to reflect gage records (Reference 7).

Discharges for Brandywine Creek were obtained from the Flood Insurance Studies for the City of Wilmington, Delaware, and the Township of Birmingham, Pennsylvania (References 8 and 9).

Hydrologic analyses for the Christina River from the CONRAIL crossing to the upstream county boundary, Christina Creek, East Branch, West Branch, Belltown Run, and Muddy Run were obtained from the original Flood Insurance Study for New Castle County (Reference 1).

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges." No discharge data were available for the streams studied in the original study.

Tidal elevation-frequency relationships for the Delaware River were prepared by the Philadelphia District of the COE (References 10 and 11). Elevation versus frequency curves were developed at five gage locations along the Delaware River between Lewes, Delaware, and Trenton, New Jersey. These curves were based on a graphical frequency analysis of the adjusted annual peak stages using Weibul plotting positions with high outlier adjustments. The analysis followed procedures outlined in Water

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TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CHRISTINA RIVER					
Downstream of the confluence of Little Mill Creek	234.0	13,100	22,900	27,600	41,700
Upstream of the confluence of Little Mill Creek	224.5	12,700	22,200	26,700	40,400
Upstream of the confluence of White Clay Creek	54.4	5,000	8,500	10,400	15,200
Downstream of the confluence of Belltown Run	37.0	4,000	6,600	8,200	12,200
Upstream of the confluence of Belltown Run	23.8	3,000	5,000	6,400	9,600
At USGS gage No. 01478000 (Coochs Bridge)	20.5	2,400	4,400	5,300	8,800
RED CLAY CREEK					
At its confluence with White Clay Creek	54.1	4,900	8,300	10,200	15,100
At USGS gage No. 01480000 (Wooddale)	47.0	4,700	7,800	9,400	14,300
At Ashland Road	32.5	3,600	6,100	7,600	11,400
WHITE CLAY CREEK					
At its confluence with the Christina River	162.0	10,400	18,300	21,500	32,100
Upstream of the confluence of Red Clay Creek	104.0	7,600	13,000	15,600	23,100
At USGS gage No. 01479000 (Near Newark)	89.1	7,200	11,800	14,200	22,000
Upstream of the confluence of Pike Creek	82.5	6,500	11,200	13,400	19,800
At USGS gage No. 01478500 (Above Newark)	66.7	6,000	9,800	11,900	17,900
TRIBUTARY TO WHITE CLAY CREEK					
At its confluence with White Clay Creek	1.62	600	1,200	1,600	2,700
MILL CREEK					
At its confluence with White Clay Creek	12.0	2,370	3,740	4,400	6,200
At USGS gage No. 01479200 (Hockessin)	4.2	1,050	1,950	2,300	3,000

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TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
PIKE CREEK					
At its confluence with White Clay Creek	6.3	1,210	2,330	3,010	5,140
At Henderson Road	5.3	1,130	2,230	2,890	4,870
LITTLE MILL CREEK					
At its confluence with the Christina River	9.5	3,700	5,100	5,800	9,500
At USGS gage No. 01480100 (Elsmere)	6.7	3,100	4,300	4,900	8,000
Upstream of the confluence of Chestnut Run	5.5	2,800	3,900	4,400	7,200
CHESTNUT RUN					
At its confluence with Little Mill Creek	1.15	1,300	1,800	2,000	3,300
BRANDYWINE CREEK					
At its confluence with the Christina River	314.0	13,000	21,500	25,600	35,500
At the Delaware-Pennsylvania boundary	295.0	13,000	18,600	22,200	34,000

Resources Council Bulletin 17A (Reference 12). Elevation versus frequency relationships required for locations between the analyzed gage locations were developed using a graphical interpolation procedure based on trends shown by profile plots of the observed peak stages of historic flood events.

A summary of peak elevation-frequency relationships for the Delaware River is shown in Table 2, "Summary of Stillwater Elevations."

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analyses were obtained using photogrammetric methods and field surveys (References 13 and 14). Cross sections were located at close intervals above and below bridges and

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TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
DELAWARE RIVER				
At the confluence with the Christina River (City of Wilmington)	7.2	8.9	9.7	11.6
At the City of New Castle	7.1	8.8	9.6	11.5
At Reedy Island	7.0	8.7	9.6	11.5
At the confluence of the Smyrna River (downstream corporate limits	6.9	8.7	9.5	11.4

culverts in order to compute the significant backwater effects of these structures in the highly urbanized areas. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 15). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations for the Christina River were obtained from the mean annual or 1-year tide on the Delaware River (Reference 11). Starting water-surface elevations for Red Clay Creek, White Clay Creek, Tributary to White Clay Creek, Mill Creek, Pike Creek, Little Mill Creek, and Chestnut Run were determined by the slope/area method. Starting water-surface elevations for Brandywine Creek were obtained from the Flood Insurance Studies for the City of Wilmington, Delaware, and the Township of Birmingham, Pennsylvania (References 8 and 9).

Channel roughness factors (Manning's "n") used in the hydraulic computations were determined by field inspection of flood plain areas and using the publication, Design of Roadside Drainage Channels (Reference 16). The channel "n" and overbank "n" values for the streams studied by detailed methods are shown in the following tabulation:

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Stream	Channel "n"	Overbank "n"
Christina River	0.035-0.045	0.075-0.090
Red Clay Creek	0.040	0.060-0.100
White Clay Creek	0.035-0.040	0.060-0.090
Tributary to White Clay Creek	0.035	0.085
Mill Creek	0.045	0.030-0.100
Pike Creek	0.030-0.035	0.035-0.100
Little Mill Creek	0.012-0.065	0.020-0.090
Chestnut Run	0.030-0.070	0.030-0.070
Brandywine Creek	0.040-0.045	0.065-0.085

Hydraulic analyses for the Christina River from the CONRAIL crossing to the upstream county boundary, Christina Creek, East Branch, West Branch, Belltown Run, and Muddy Run were obtained from the original Flood Insurance Study for New Castle County (Reference 1). No "n" values were available for these streams.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the county. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (References 14 and 17). These maps were supplemented with topographic contour data furnished by New Castle County (Reference 18).

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For the streams studied by approximate methods, the boundary of the 100-year flood was delineated using the original Flood Insurance Study for New Castle County, field inspection, engineering judgment, and topographic contour data (References 1 and 18).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

No floodway data were available for Christina Creek, East Branch, West Branch, Belltown Run, Muddy Run, Sunset Lake, and Becks Pond in the original Flood Insurance Study for New Castle County, therefore, no floodways for these streams are shown in this study.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths for the Christina River, White Clay Creek, Little Mill Creek, Chestnut Run, and Brandywine Creek extend beyond the county boundary.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Christina River								
A	14,855	616[2]	6,636	4.0	9.7	9.2[3]	9.2	0.0
B	18,970	345[2]	3,999	6.7	10.5	10.5	10.5	0.0
C	33,490	1,299	12,579	0.8	13.8	13.8	14.8	1.0
D	39,545	1,275	11,743	0.9	14.2	14.2	15.1	0.9
E	43,300	685	7,482	1.3	14.4	14.4	15.4	1.0
F	45,710	825	9,460	1.0	14.7	14.7	15.6	0.9
G	48,870	700	7,542	1.3	15.0	15.0	15.9	0.9
H	52,165	775	9,248	1.0	15.4	15.4	16.3	0.9
I	56,750	587	6,787	1.4	16.5	16.5	17.3	0.8
J	58,500	753	9,130	1.0	16.6	16.6	17.3	0.7
K	61,700	672	5,291	1.7	17.5	17.5	18.0	0.5
L	63,850	868	5,714	1.6	17.9	17.9	18.4	0.5
M	66,990	700	5,665	1.6	18.7	18.7	19.1	0.4
N	68,320	390	2,397	3.7	19.0	19.0	19.3	0.3
O	71,390	458	2,786	3.2	21.6	21.6	22.0	0.4
P	74,630	475	4,072	2.0	24.0	24.0	24.9	0.9
Q	76,280	450	3,930	2.1	24.8	24.8	25.6	0.8
R	80,720	663	4,449	1.4	26.3	26.3	27.2	0.9
S	81,800	542	3,344	1.9	27.3	27.3	28.1	0.8
T	87,800	650	3,222	1.7	30.7	30.7	31.5	0.8
U	91,725	668	2,763	1.9	34.1	34.1	35.1	1.0
V	94,360	98	695	7.6	39.0	39.0	39.5	0.5
W	96,470	434	3,262	1.6	43.0	43.0	43.7	0.7

[1]Feet above county boundary

[2]This width extends beyond county boundary

[3]Elevation computed without consideration of backwater from Delaware River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

FLOODWAY DATA

CHRISTINA RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Christina River (continued)								
X	97,460[1]	336	1,807	2.9	43.1	43.1	44.1	1.0
Y	99,635[1]	161	723	7.3	48.6	48.6	48.7	0.1
Z	102,280[1]	136	1,056	5.0	64.3	64.3	64.3	0.0
Red Clay Creek								
A	1,000[2]	286	1,968	5.2	19.3	18.2[3]	19.2	1.0
B	2,180[2]	590	4,025	2.5	21.1	21.1	21.6	0.5
C	4,955[2]	392	2,560	4.0	23.8	23.8	24.7	0.9
D	7,430[2]	400	3,337	3.1	26.2	26.2	26.7	0.5
E	8,880[2]	200	1,406	7.0	27.2	27.2	27.8	0.6
F	10,060[2]	200	1,778	5.6	40.9	40.9	40.9	0.0
G	11,100[2]	270	2,183	4.5	43.4	43.4	44.1	0.7
H	12,810[2]	240	2,409	4.1	53.4	53.4	54.4	1.0
I	13,420[2]	280	2,911	3.4	54.8	54.8	55.5	0.7
J	14,155[2]	250	1,574	6.3	55.3	55.3	55.9	0.6
K	15,560[2]	230	1,875	5.2	61.8	61.8	62.2	0.4
L	17,300[2]	180	991	9.8	67.8	67.8	67.8	0.0
M	18,550[2]	167	1,350	7.2	72.2	72.2	72.5	0.3
N	20,000[2]	184	1,978	4.9	79.2	79.2	79.9	0.7
O	20,690[2]	184	1,665	5.8	79.8	79.8	80.4	0.6
P	22,670[2]	165	896	10.6	84.6	84.6	85.0	0.4

[1]Feet above county boundary

[2]Feet above confluence with White Clay Creek

[3]Elevation computed without consideration of backwater from White Clay Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

FLOODWAY DATA

CHRISTINA RIVER - RED CLAY CREEK

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Red Clay Creek (continued)								
Q	23,970	180	1,382	6.9	90.7	90.7	90.9	0.2
R	25,540	371	2,753	3.4	93.2	93.2	94.1	0.9
S	26,660	178	1,595	5.9	95.7	95.7	95.8	0.1
T	30,325	281	1,836	5.1	100.3	100.3	101.2	0.9
U	32,560	158	2,189	4.3	111.9	111.9	112.5	0.6
V	34,200	254	2,042	4.3	113.7	113.7	114.2	0.5
W	36,860	297	2,258	3.9	118.1	118.1	118.5	0.4
X	39,060	440	3,610	2.5	121.0	121.0	122.0	1.0
Y	40,330	212	1,904	4.4	121.9	121.9	122.8	0.9
Z	42,240	145	1,105	7.7	127.0	127.0	127.6	0.6
AA	46,660	111	883	9.2	137.9	137.9	138.8	0.9
AB	48,310	152	1,580	5.1	143.3	143.3	143.5	0.2
AC	50,465	177	1,387	5.6	146.4	146.4	147.2	0.8
AD	52,440	391	3,886	2.0	151.5	151.5	152.3	0.8
AE	54,220	538	2,331	3.3	152.3	152.3	153.3	1.0
AF	57,860	172	1,409	5.4	163.0	163.0	163.5	0.5
AG	59,840	113	878	8.7	173.6	173.6	173.6	0.0
AH	60,915	260	1,663	4.6	176.7	176.7	176.8	0.1
AI	62,510	151	1,191	6.4	181.5	181.5	181.7	0.2
AJ	64,060	178	1,288	5.9	185.2	185.2	185.6	0.4
AK	64,940	135	1,078	7.0	187.7	187.7	187.8	0.1
AL	66,310	138	1,256	6.0	191.4	191.4	192.2	0.8

[1]Feet above confluence with White Clay Creek

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

FLOODWAY DATA

RED CLAY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
White Clay Creek								
A	5,425	1,300	9,444	2.3	13.2	10.1[3]	10.8	0.7
B	14,990	1,200	13,448	1.2	19.4	19.4	20.3	0.9
C	18,700	800	5,596	2.8	21.5	21.5	22.4	0.9
D	24,965	750	4,389	3.2	25.6	25.6	26.5	0.9
E	25,905	600	3,491	4.1	28.4	28.4	28.8	0.4
F	28,395	652	5,300	2.7	31.7	31.7	32.4	0.7
G	31,510	400	3,423	3.9	34.0	34.0	34.8	0.8
H	33,090	300	3,656	3.7	39.0	39.0	39.5	0.5
I	34,705	399	3,605	3.7	39.7	39.7	40.6	0.9
J	36,630	304	2,638	5.1	41.6	41.6	42.3	0.7
K	38,450	429	3,366	4.0	43.8	43.8	44.7	0.9
L	41,140	470	4,123	3.2	47.5	47.5	48.3	0.8
M	43,340	265	2,011	6.7	49.7	49.7	50.3	0.6
N	44,960	187	2,091	6.4	53.4	53.4	54.2	0.8
O	47,415	180[2]	1,704	7.9	60.3	60.3	60.3	0.0
P	52,045	260[2]	2,581	4.9	68.3	68.3	68.7	0.4
Q	52,855	275[2]	1,791	7.0	69.3	69.3	69.8	0.5
R	60,120	455	3,674	3.4	86.6	86.6	87.3	0.7
S	62,380	179	1,441	8.3	89.1	89.1	89.7	0.6
T	64,820	216	2,107	5.6	93.8	93.8	94.6	0.8
U	69,220	432	3,186	3.7	103.8	103.8	104.5	0.7
V	70,760	728	5,533	2.2	105.4	105.4	106.2	0.8
W	74,485	803	5,367	2.2	110.7	110.7	111.6	0.9

[1]Feet above confluence with Christina River
[2]This width extends beyond county boundary
[3]Elevation computed without consideration of backwater from Christina River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOODWAY DATA

WHITE CLAY CREEK

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Creek (continued)								
AE	48,030	120	301	7.6	305.1	305.1	305.2	0.1
Pike Creek								
A	600	190	599	5.0	33.8	30.7[2]	31.6	0.9
B	1,960	140	519	5.8	37.8	37.7[2]	38.3	0.6
C	2,290	250	903	3.3	41.3	41.3	41.3	0.0
D	2,860	170	469	6.4	43.0	43.0	43.0	0.0
E	4,210	121	596	5.1	53.7	53.7	53.7	0.0
F	5,460	140	450	6.7	59.2	59.2	59.2	0.0
G	6,760	120	424	7.1	67.3	67.3	67.3	0.0
H	9,160	105	377	7.7	85.2	85.2	85.2	0.0
I	10,370	140	389	7.4	95.7	95.7	95.7	0.0
J	13,620	140	401	7.2	116.5	116.5	116.5	0.0
K	15,100	205	544	5.3	125.5	125.5	125.7	0.2
L	16,140	139	341	7.3	131.7	131.7	131.7	0.0
M	17,220	133	336	7.4	141.2	141.2	141.3	0.1
N	18,840	165	661	3.8	153.4	153.4	153.9	0.5
O	20,840	80	260	9.5	164.6	164.6	164.6	0.0
P	21,870	175	457	5.4	172.9	172.9	173.3	0.4

[1]Feet above confluence with White Clay Creek

[2]Elevation computed without consideration of backwater from White Clay Creek

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK - PIKE CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Little Mill Creek								
A	2,090[1]	1,698	10,817	0.5	9.9	9.9	9.9	0.0
B	4,690[1]	260	2,232	2.6	15.9	15.9	16.1	0.2
C	6,690[1]	149	814	7.1	16.0	16.0	17.0	1.0
D	9,100[1]	180	615	9.4	27.1	27.1	27.1	0.0
E	10,530[1]	212[4]	820	6.0	59.4	59.4	59.4	0.0
F	11,715[1]	264[4]	1,507	3.3	64.0	64.0	64.0	0.0
G	14,475[1]	320[4]	1,019	4.8	67.0	67.0	67.1	0.1
H	17,050[1]	742[4]	5,395	0.9	75.1	75.1	76.1	1.0
I	18,300[1]	314[4]	1,299	3.8	75.9	75.9	76.9	1.0
J	20,765[1]	264	753	5.8	84.5	84.5	84.5	0.0
K	21,690[1]	286	1,858	2.4	88.2	88.2	88.8	0.6
Chestnut Run								
A	665[2]	190[4]	661	3.0	77.7	77.7	78.5	0.8
B	1,865[2]	162[4]	299	6.7	83.6	83.6	83.6	0.0
C	3,020[2]	121[4]	548	3.6	90.3	90.3	91.3	1.0
D	4,550[2]	81	291	6.9	97.5	97.5	97.6	0.1
Brandywine Creek								
A	3.40[3]	142[3]	2,122	12.3	39.2	39.2	40.2	1.0

[1]Feet above confluence with Christina River
[2]Feet above confluence with Little Mill Creek
[3]Miles above confluence with Christina River
[4]This width extends beyond corporate limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

FLOODWAY DATA

LITTLE MILL CREEK - CHESTNUT RUN - BRANDYWINE CREEK

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
White Clay Creek (continued)								
X	76,115[1]	641	2,862	4.2	112.9	112.9	113.9	1.0
Y	77,800[1]	207	1,429	8.3	117.7	117.7	117.7	0.0
Tributary to White Clay Creek								
A	3,655[2]	495	1,745	0.9	13.2	5.9[3]	6.6	0.7
B	5,870[2]	350	2,208	0.7	22.0	9.5[3]	10.3	0.8
C	7,060[2]	193	855	1.7	22.3	9.6[3]	10.5	0.9
D	7,965[2]	143	406	3.6	22.5	13.0[3]	13.4	0.4
Mill Creek								
A	440[2]	160	466	9.4	19.5	10.7[3]	10.7	0.0
B	1,400[2]	160	1,353	3.3	19.5	19.2[3]	19.2	0.0
C	2,240[2]	250	1,742	2.5	19.5	19.5	20.1	0.6
D	2,950[2]	250	1,779	2.5	19.8	19.8	20.8	1.0
E	5,070[2]	160	1,396	3.2	29.3	29.3	29.4	0.1
F	5,835[2]	160	855	5.1	29.6	29.6	30.6	1.0
G	7,590[2]	170	541	8.1	34.7	34.7	35.1	0.4
H	10,830[2]	160	534	8.2	59.2	59.2	59.3	0.1
I	11,680[2]	149	456	9.6	73.7	73.7	73.7	0.0

[1]Feet above confluence with Christina River
[2]Feet above confluence with White Clay Creek
[3]Elevation computed without consideration of backwater from White Clay Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

FLOODWAY DATA

WHITE CLAY CREEK - TRIBUTARY TO WHITE CLAY CREEK - MILL CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Creek (continued)								
J	14,220	160	674	6.5	92.3	92.3	92.8	0.5
K	17,210	200	912	4.8	106.1	106.1	106.8	0.7
L	17,550	250	985	4.5	109.1	109.1	109.8	0.7
M	18,160	200	723	6.1	113.4	113.4	114.4	1.0
N	19,330	160	1,425	3.1	119.1	119.1	119.2	0.1
O	22,460	96	383	11.5	149.9	149.9	149.9	0.0
P	23,610	130	695	6.3	163.6	163.6	163.9	0.3
Q	25,400	170	930	3.2	170.2	170.2	171.2	1.0
R	27,210	150	419	7.2	175.9	175.9	176.0	0.1
S	28,030	200	961	3.1	180.4	180.4	180.9	0.5
T	28,660	160	552	5.4	182.2	182.2	182.5	0.3
U	31,260	250	1,157	2.6	199.2	199.2	199.8	0.6
V	33,100	128	367	8.2	208.0	208.0	208.1	0.1
W	34,550	150	556	5.4	217.8	217.8	217.8	0.0
X	35,595	150	992	2.3	226.7	226.7	226.7	0.0
Y	37,050	140	562	4.1	227.9	227.9	228.9	1.0
Z	38,400	140	645	3.6	232.3	232.3	232.8	0.5
AA	41,170	250	1,182	1.9	245.2	245.2	246.2	1.0
AB	43,180	150	965	2.4	255.8	255.8	255.9	0.1
AC	45,670	120	280	8.2	270.0	270.0	270.1	0.1
AD	46,900	120	375	6.1	293.1	293.1	293.1	0.0

[1]Feet above confluence with White Clay Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK

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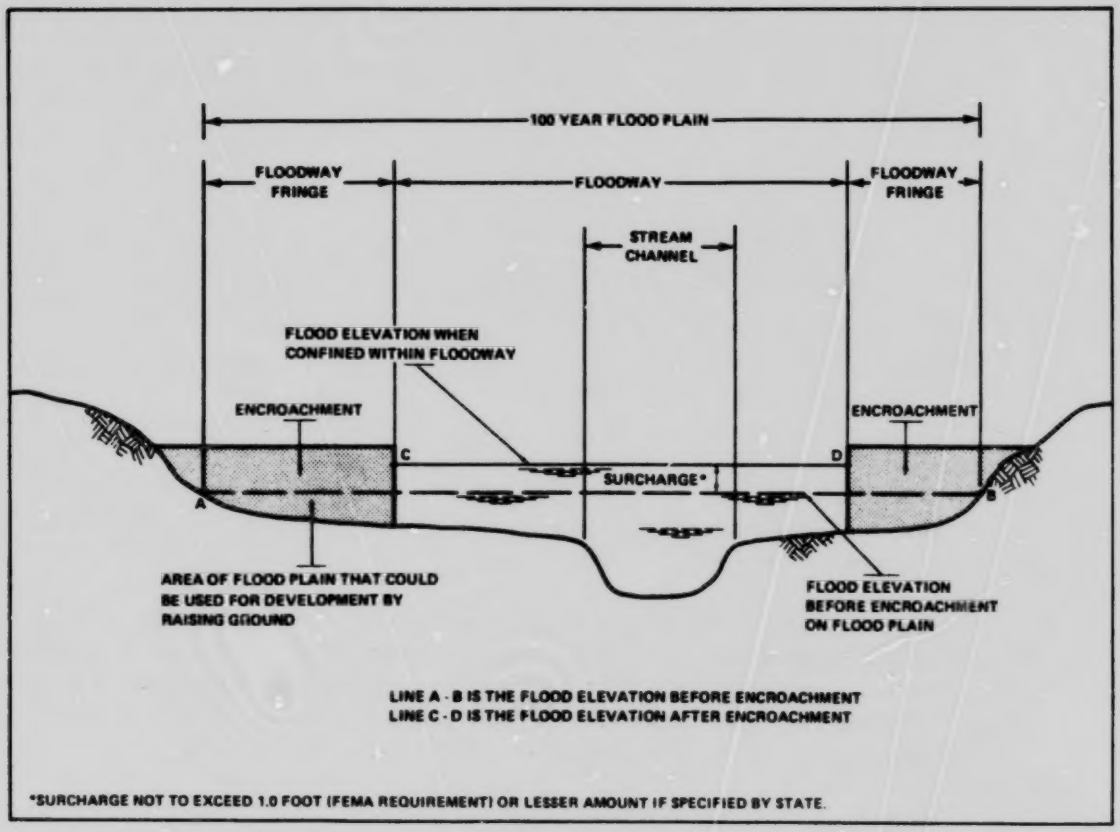
The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 3 for certain downstream cross sections of the Christina River, Red Clay Creek, White Clay Creek, Tributary to White Clay Creek, Mill Creek, and Pike Creek are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

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5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in New Castle County.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the riverine flooding sources of New Castle County are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

In tidal areas, reaches are limited to the distance for which the 100-year flood elevation does not vary more than 1.0 foot. Using these criteria, one reach was required for the tidal flooding source of New Castle County. The location of this reach is shown on the Flood Insurance Rate Map and summarized in Table 4.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Delaware River							
Reach 1	05,15, 20,30, 35,45, 50,60, 75,85, 95,100, 110	-2.5	-1.7	+1.9	025	A5	10
Christina River							
Reach 1	30,40, 45	-4.2	-1.2	+2.9	040	A8	Varies
Reach 2	40,45	-2.8	-0.9	+2.2	030	A6	Varies
Reach 3	40	*	*	*	020	A4	Varies
Red Clay Creek							
Reach 1	05,10, 30	-3.5	-1.1	+2.3	035	A7	Varies

*Data not available

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

DELAWARE RIVER - CHRISTINA RIVER - RED CLAY CREEK

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
White Clay Creek							
Reach 1	30,45	-4.7	-1.3	+3.0	045	A9	Varies
Reach 2	25,30, 40,45	-3.2	-1.0	+2.4	030	A6	Varies
Reach 3	25,40	-3.3	-1.0	+2.2	035	A7	Varies
Mill Creek							
Reach 1	05,25, 30	-2.2	-0.6	+1.3	020	A4	Varies
Reach 2	05	-1.0	-0.2	+0.4	010	A2	Varies
Pike Creek							
Reach 1	25	-1.3	-0.5	+1.2	015	A3	Varies
Reach 2	25	-2.5	-0.7	+2.1	025	A5	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

WHITE CLAY CREEK - MILL CREEK - PIKE CREEK

BEST COPY AVAILABLE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Little Mill Creek							
Reach 1	30	-1.2	-0.4	+1.6	010	A2	Varies
Reach 2	30	-2.3	-0.5	+1.6	025	A5	Varies
Reach 3	30	-1.2	-0.3	+1.2	010	A2	Varies
Chestnut Run							
Reach 1	30	-0.7	-0.2	+0.9	005	A1	Varies
Brandywine Creek							
Reach 1	30,35	-4.1	-1.3	+2.9	040	A8	Varies
Reach 2	10	-3.6	-1.3	+3.6	035	A7	Varies
Christina Creek							
Reach 1	25,40	*	*	*	020	A4	Varies
Reach 2	25	*	*	*	025	A5	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

*Data not available

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

LITTLE MILL CREEK - CHESTNUT RUN - BRANDYWINE CREEK - CHRISTINA CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
East Branch Reach 1	25	*	*	*	025	A5	Varies
West Branch Reach 1	40	*	*	*	015	A3	Varies
Belltown Run Reach 1	55	*	*	*	020	A4	Varies
Muddy Run Reach 1	55	*	*	*	015	A3	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

*Data not available

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

EAST BRANCH - WEST BRANCH - BELLTOWN RUN - MUDDY RUN

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5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A1, A2, A3, A4, A5, A6, A7, A8, and A9:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 4.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for New Castle County is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

This Flood Insurance Study was coordinated to ensure consistency of results with the Metropolitan Christina River Basin Study and the Delaware River Basin Study (References 7 and 11). Technical data contained in the original Flood

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Insurance Study for New Castle County and in several COE Flood Plain Information reports are superseded by information in this study (References 1, 19, 20, 21, 22, 23, 24, 25, and 26).

Flood Insurance Studies have been completed for the Township of Birmingham, Pennsylvania, the Town of Middletown, Delaware, the Town of Clayton, Delaware, the Town of Smyrna, Delaware, the Township of London Britain, Pennsylvania, the Town of Lower Chichester, Pennsylvania, Cecil County, Maryland, and Kent County, Maryland, (References 9, 27, 28, 29, 30, 31, 32, and 33). The results of this study are in exact agreement with the results of those studies.

Flood Insurance Studies for the City of Wilmington, Delaware, the City of Delaware City, Delaware, Kent County, Delaware, the Township of Kennett, Pennsylvania, the Township of Pennsbury, Pennsylvania, the Borough of Marcus Hook, Pennsylvania, the Township of Lower Alloways Creek, New Jersey, the Township of Oldsman, New Jersey, the Borough of Penns Grove, New Jersey, the Township of Elsinboro, New Jersey, the Township of Pennsville, New Jersey, and the Township of Greenwich, New Jersey, also have been completed (References 8, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, and 44). There are minor discrepancies between this study and those studies. The differences in the 10-, 50-, and 100-year tide frequency elevations are due to an updated tide frequency analysis for the Delaware River. Differences in the elevations are all within 0.5 foot. The major difference in the 500-year tide frequency elevation was because the Standard Project Tide was used previously as the 500-year tide frequency. It has since been determined that on the Delaware River, the 500-year tide frequency stages are lower than the Standard Project Tide. Consequently, differences in the 500-year tide frequency elevations exist.

Flood Insurance Studies for the Cities of Newark and New Castle, Delaware, and the Towns of Elsmere and Newport, Delaware, are currently being prepared (References 45, 46, 47, and 48). The results of those studies will be in exact agreement with the results of this study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region III Office, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

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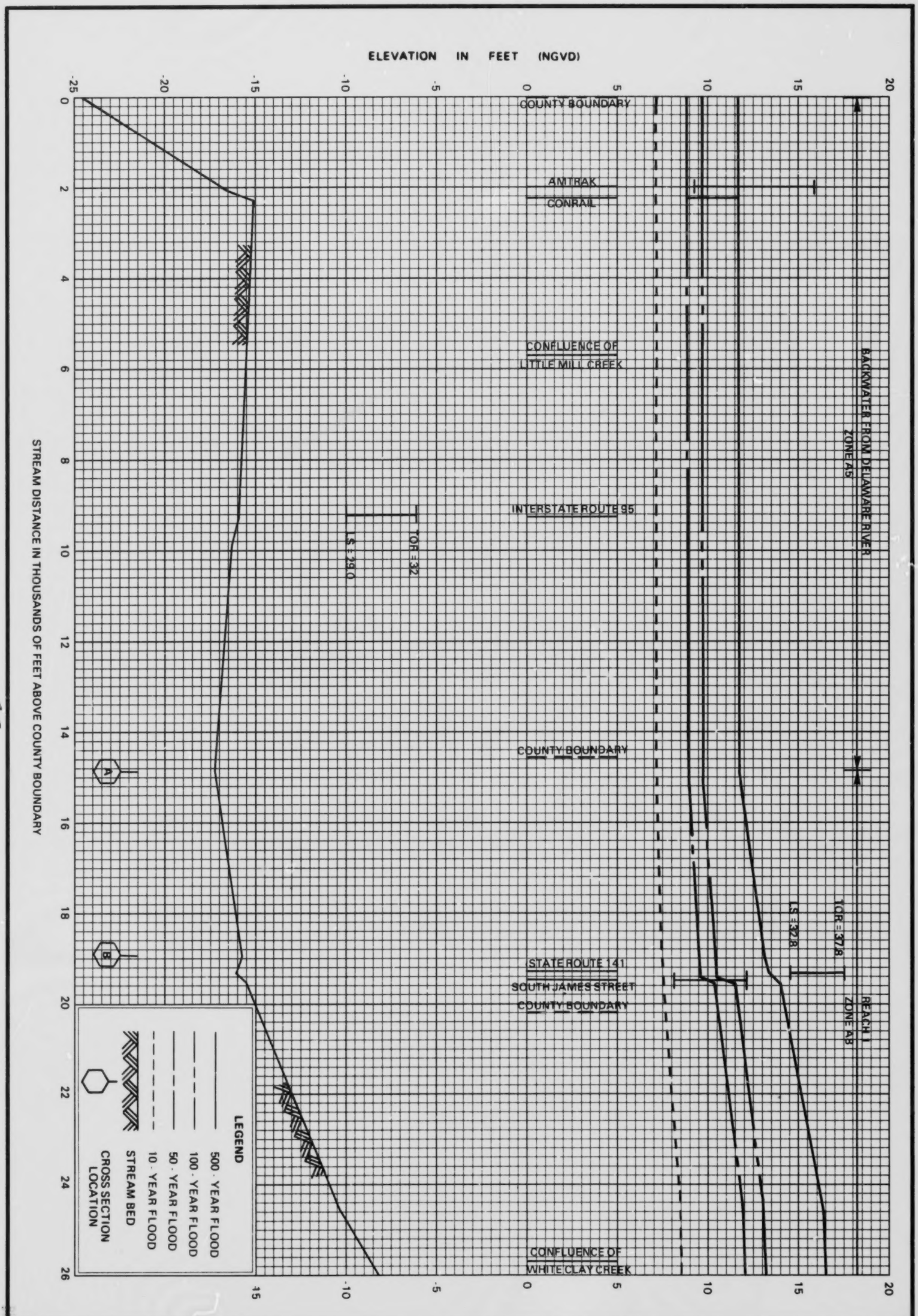

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

CHRISTINA RIVER

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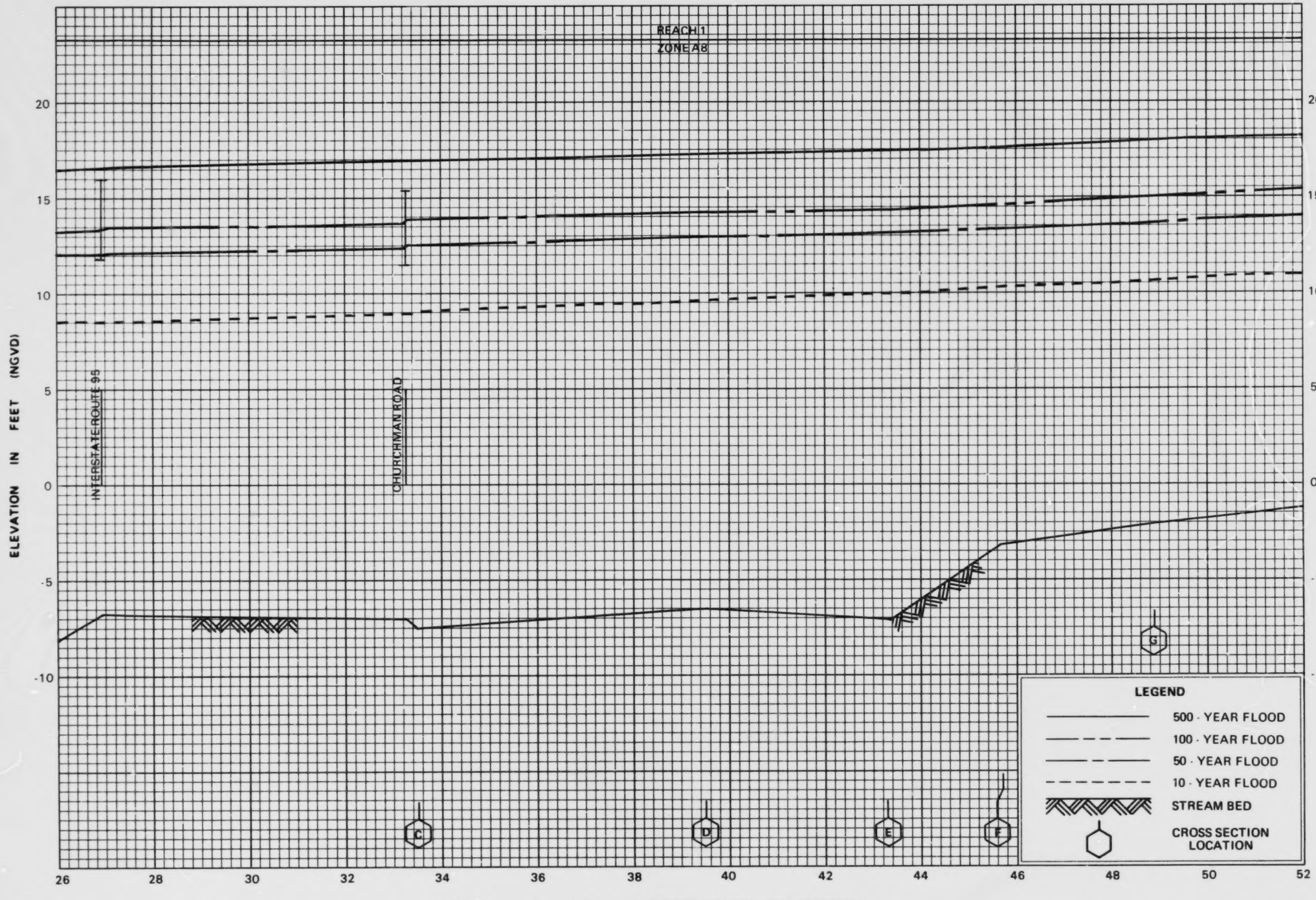

FLOOD PROFILES

CHRISTINA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

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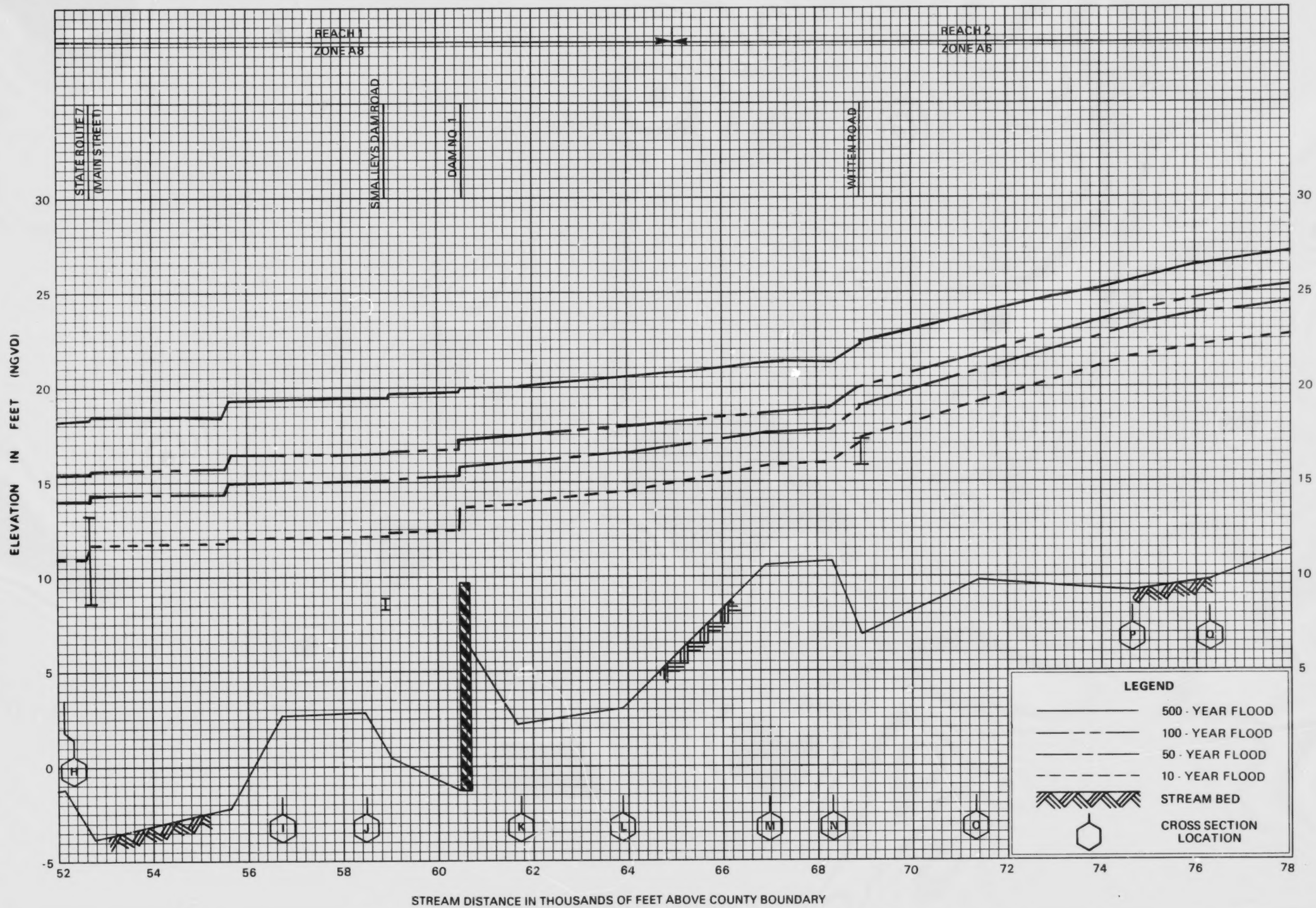

FLOOD PROFILES

CHRISTINA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

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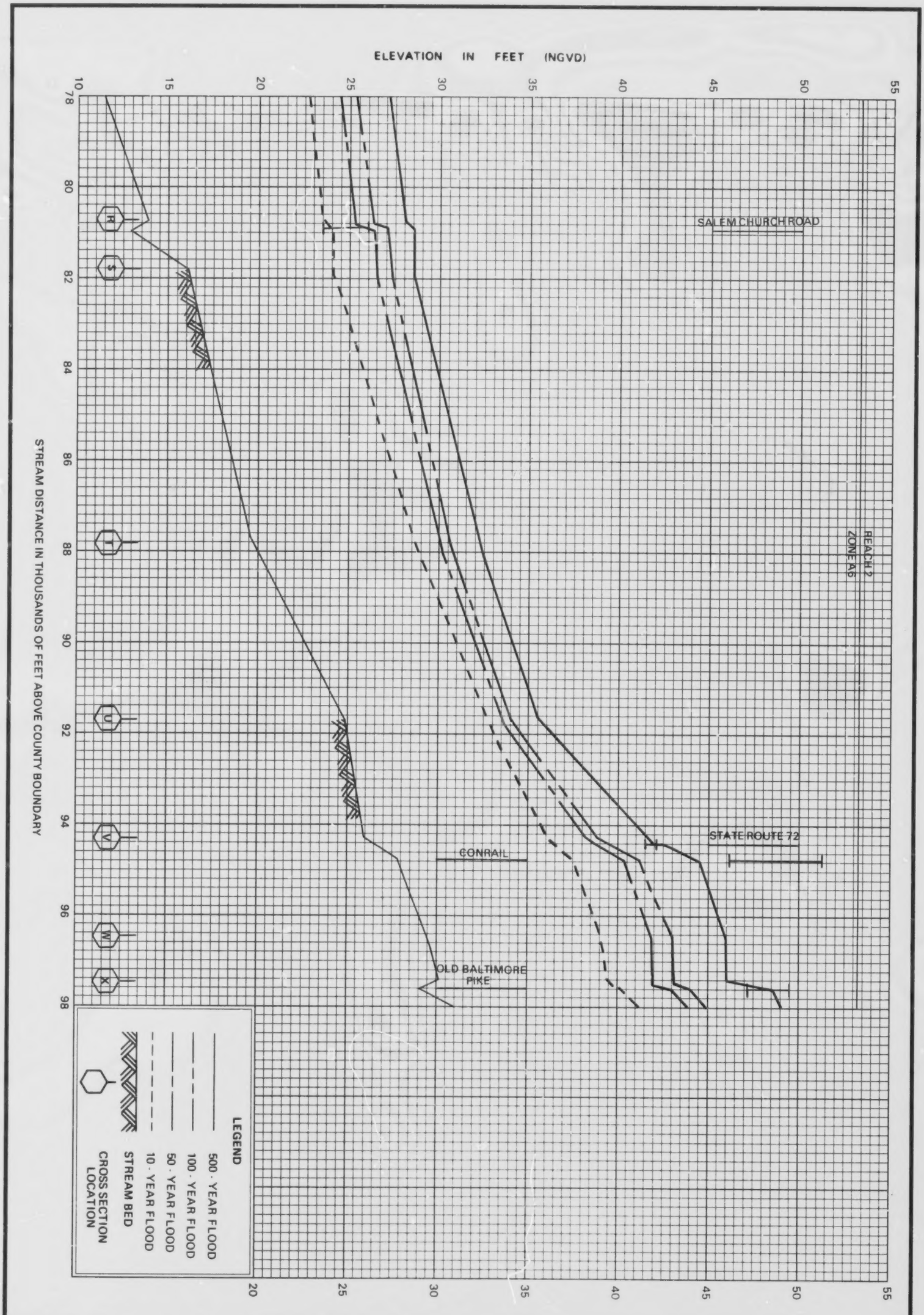

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

CHRISTINA RIVER

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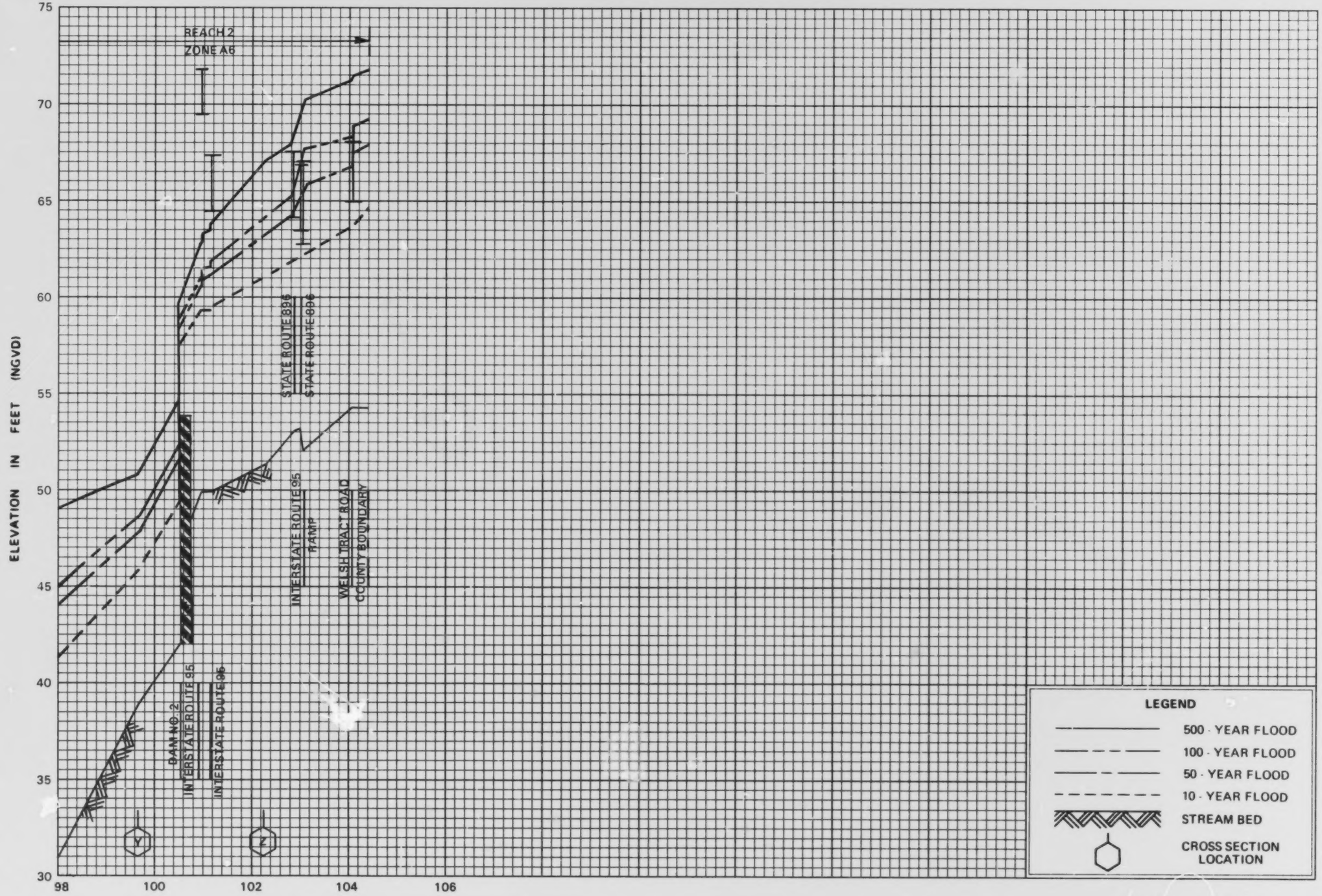

FLOOD PROFILES

CHRISTINA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

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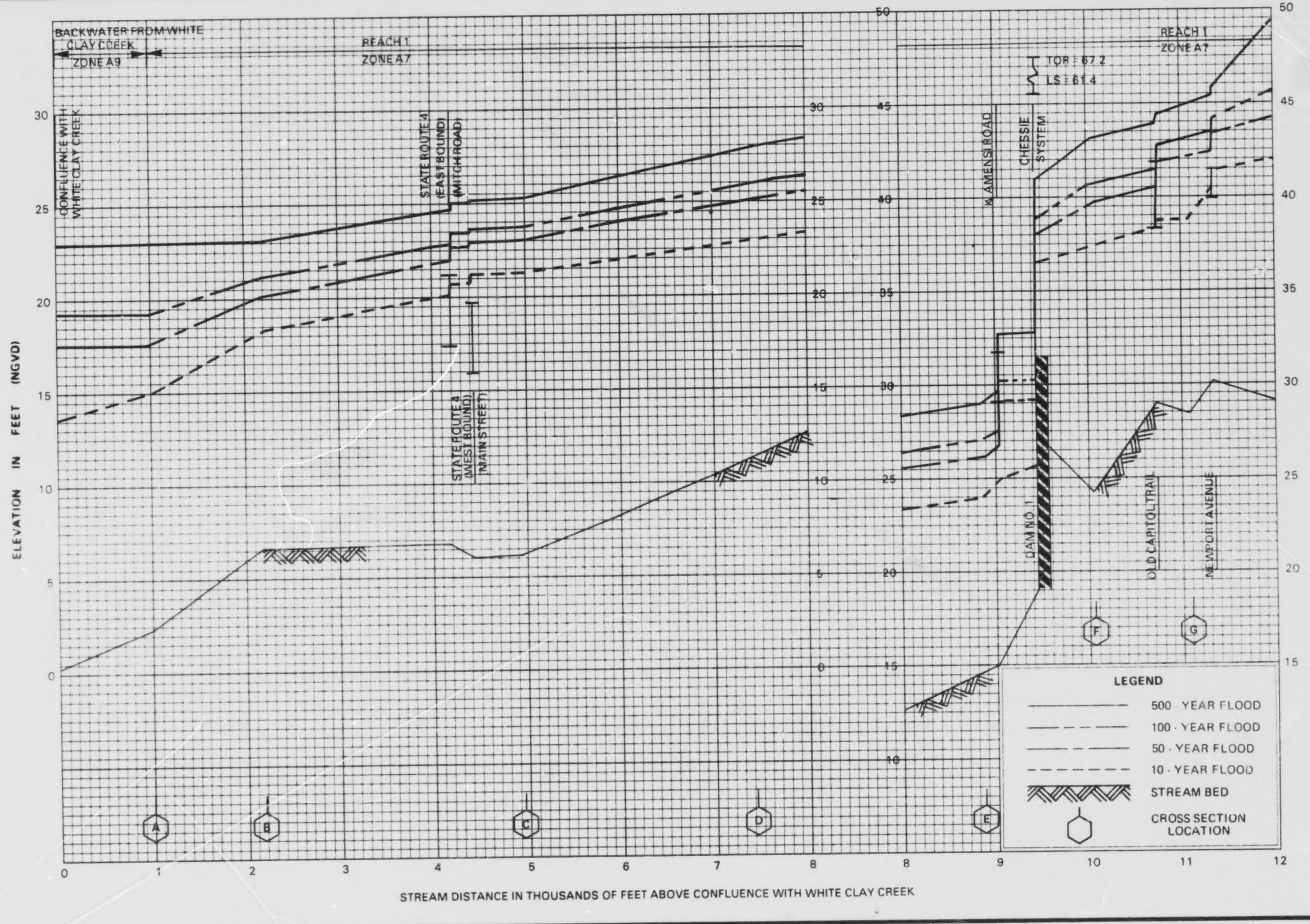

FLOOD PROFILES

RED CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

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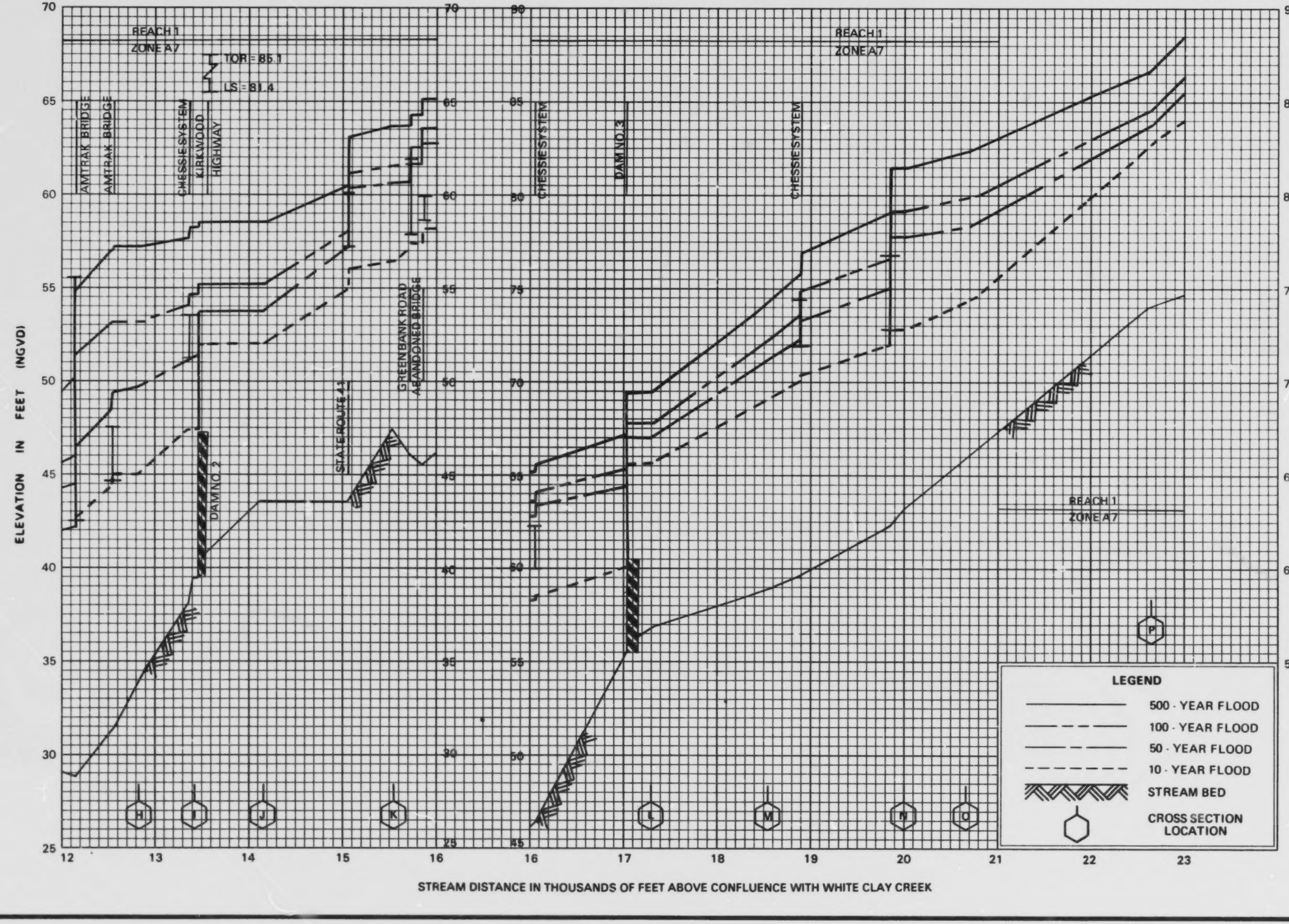

FLOOD PROFILES

RED CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

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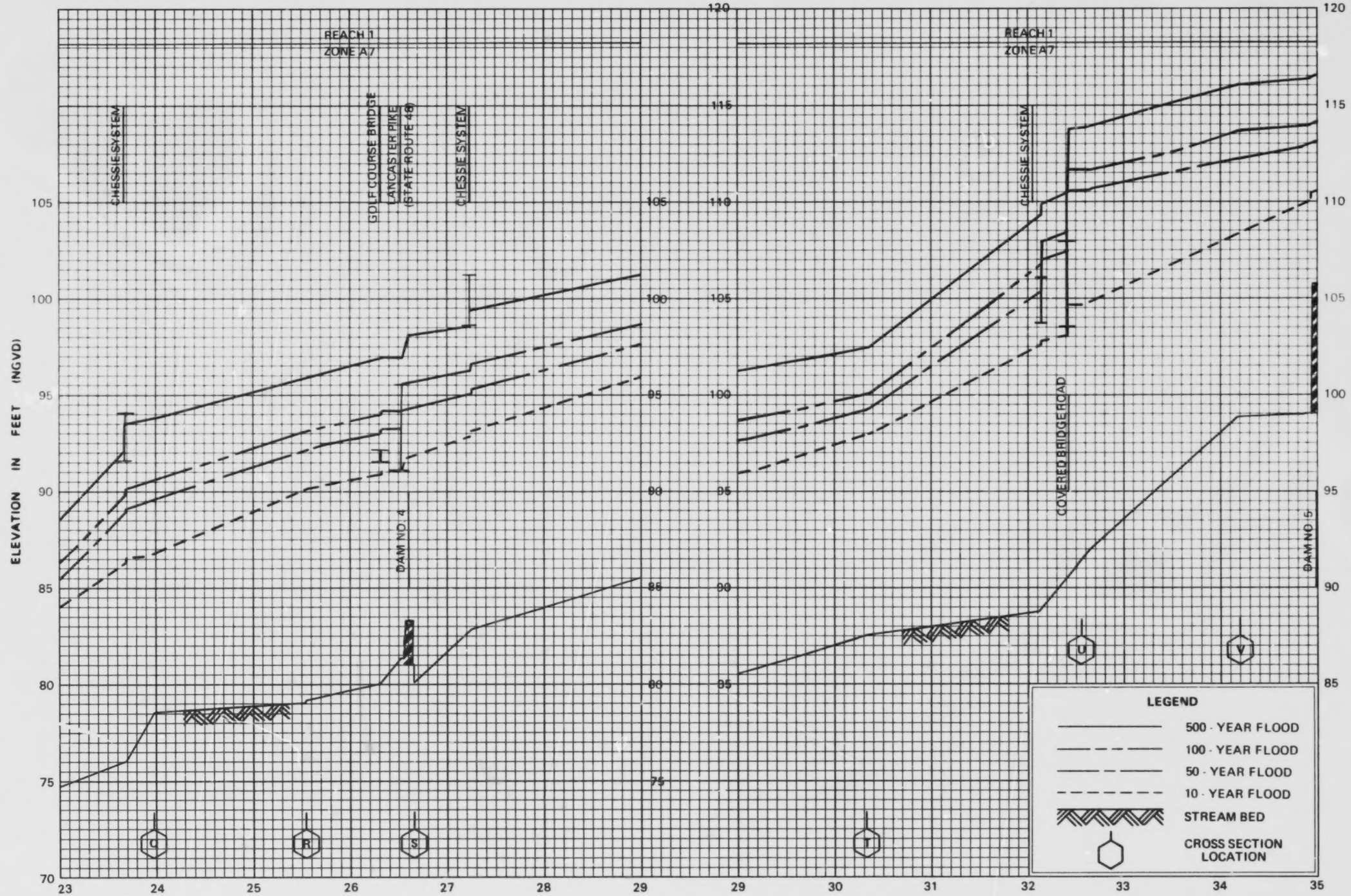

FLOOD PROFILES

RED CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

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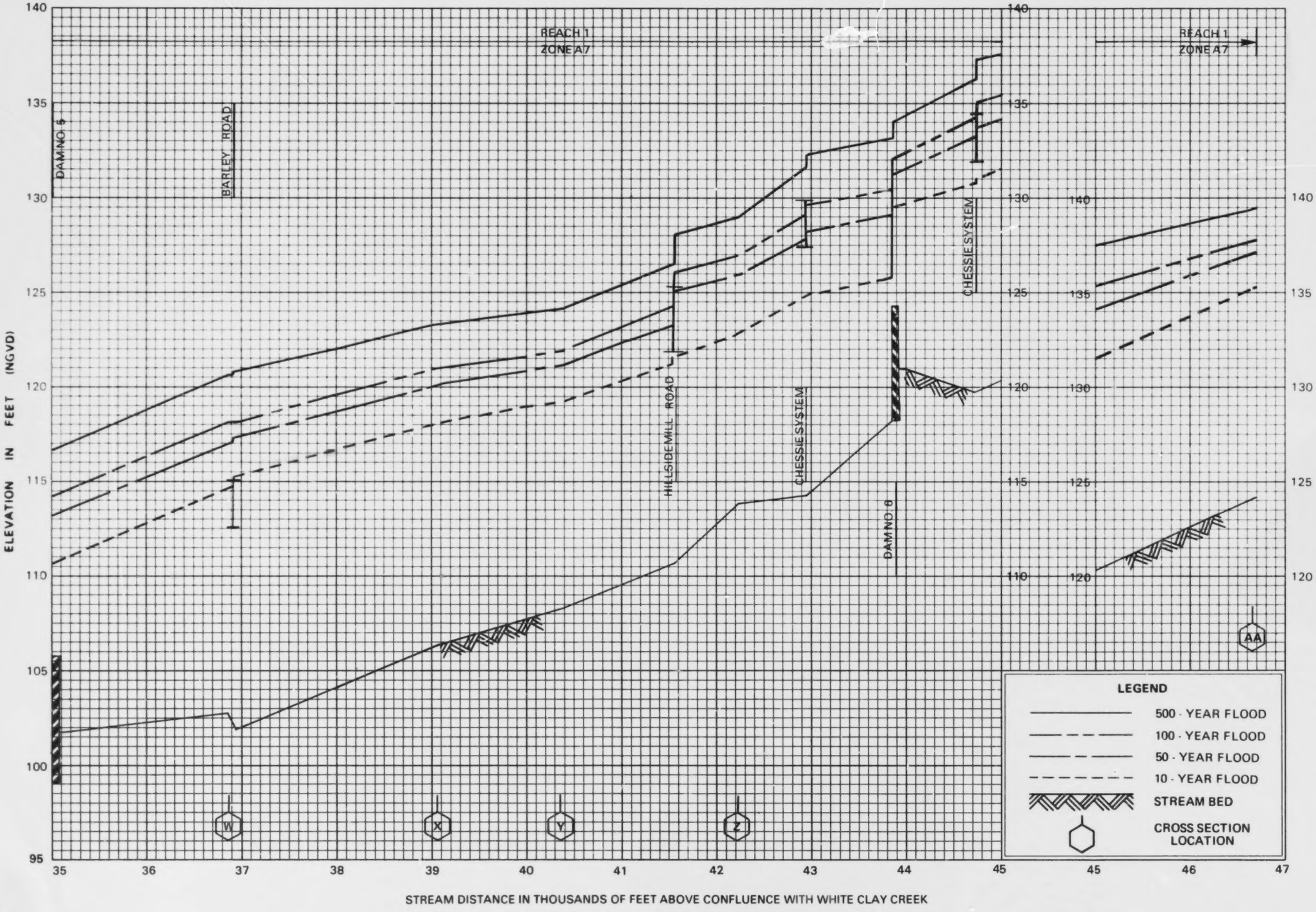

FLOOD PROFILES

RED CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

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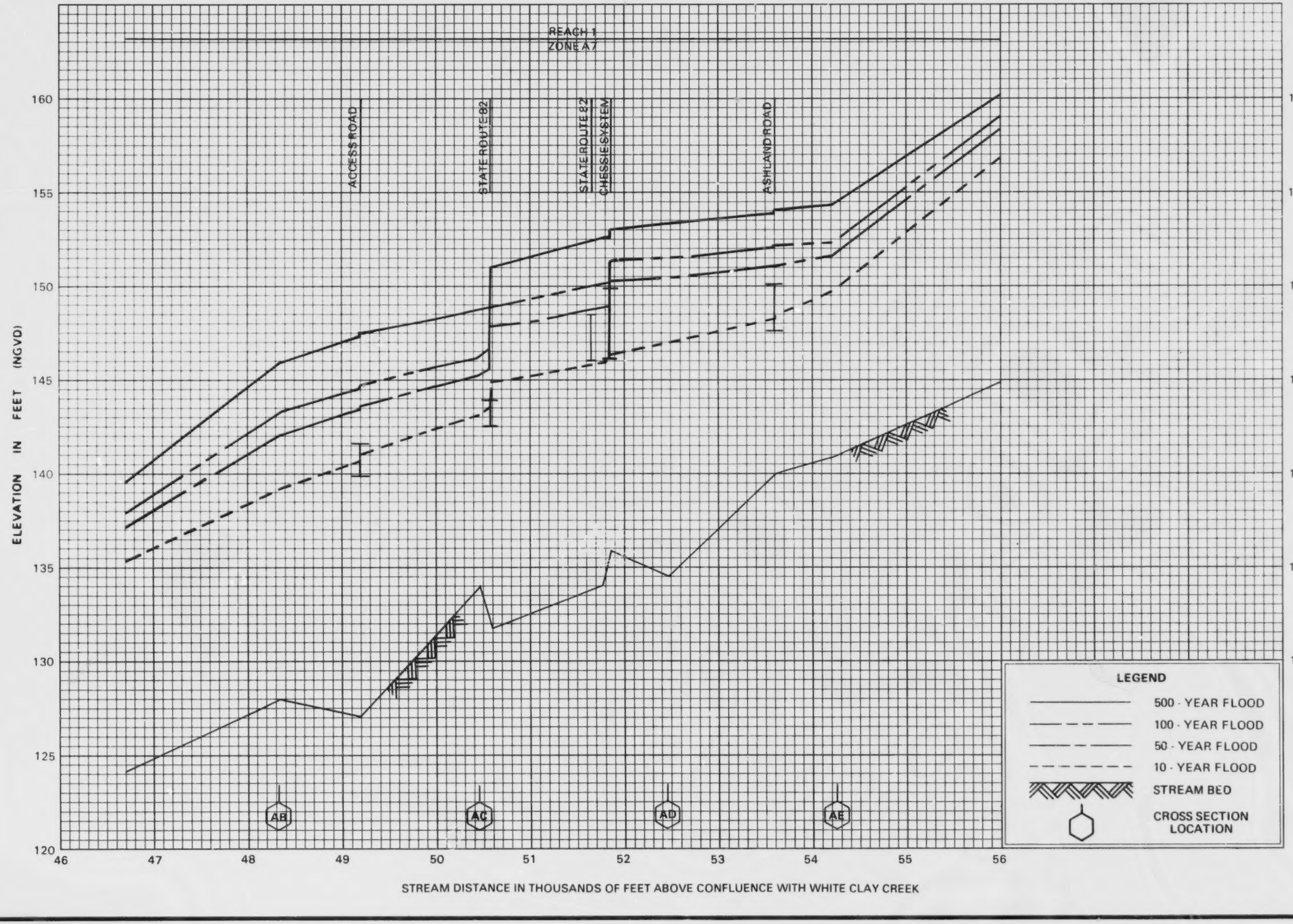

FLOOD PROFILES

RED CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

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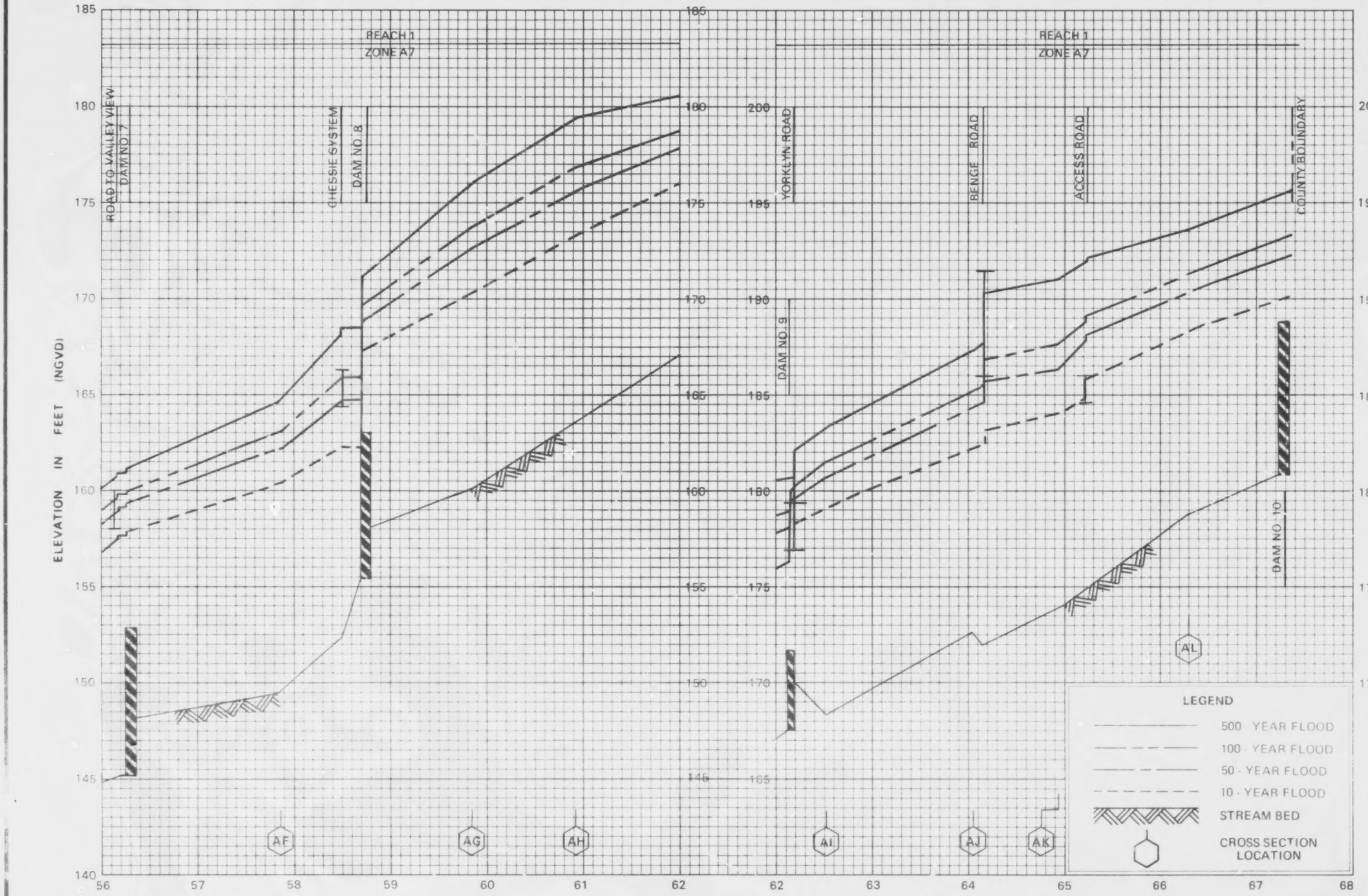

FLOOD PROFILES

RED CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

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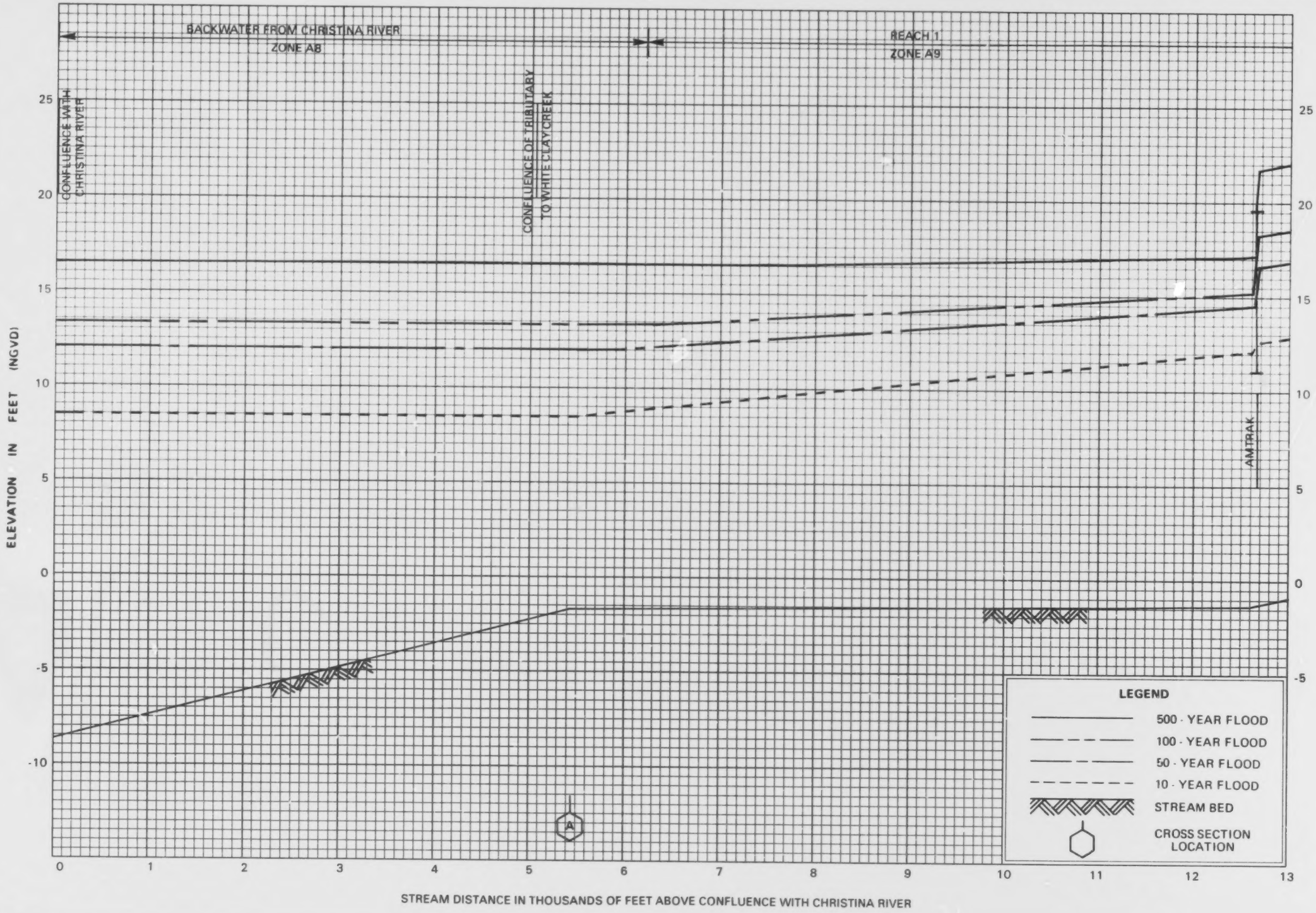

FLOOD PROFILES

WHITE CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

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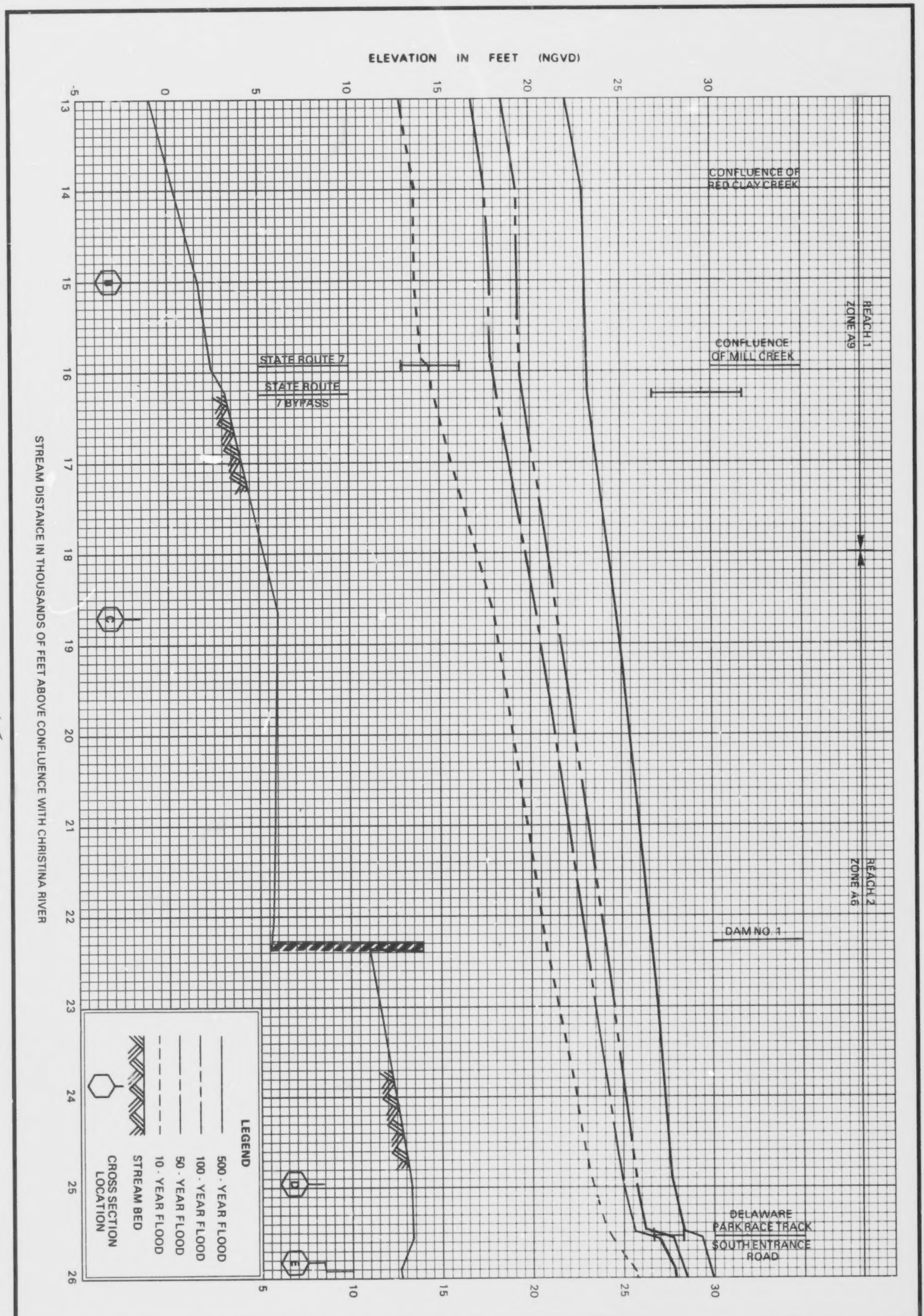

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

WHITE CLAY CREEK

13P

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REACH 2
ZONE A6

CHESSIE SYSTEM

CONFLUENCE OF PIKE CREEK

OLD HARMONY ROAD

HARMONY ROAD

RED MILL ROAD

ELEVATION IN FEET (NGVD)

50
45
40
35
30
25
20
15
10

26 27 28 29 30 31 32 33 34 35 36 37 38 39

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CONFLUENCE WITH CHRISTINA RIVER

E F G H I J K

LEGEND

- 500 - YEAR FLOOD
- 100 - YEAR FLOOD
- 50 - YEAR FLOOD
- 10 - YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

WHITE CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

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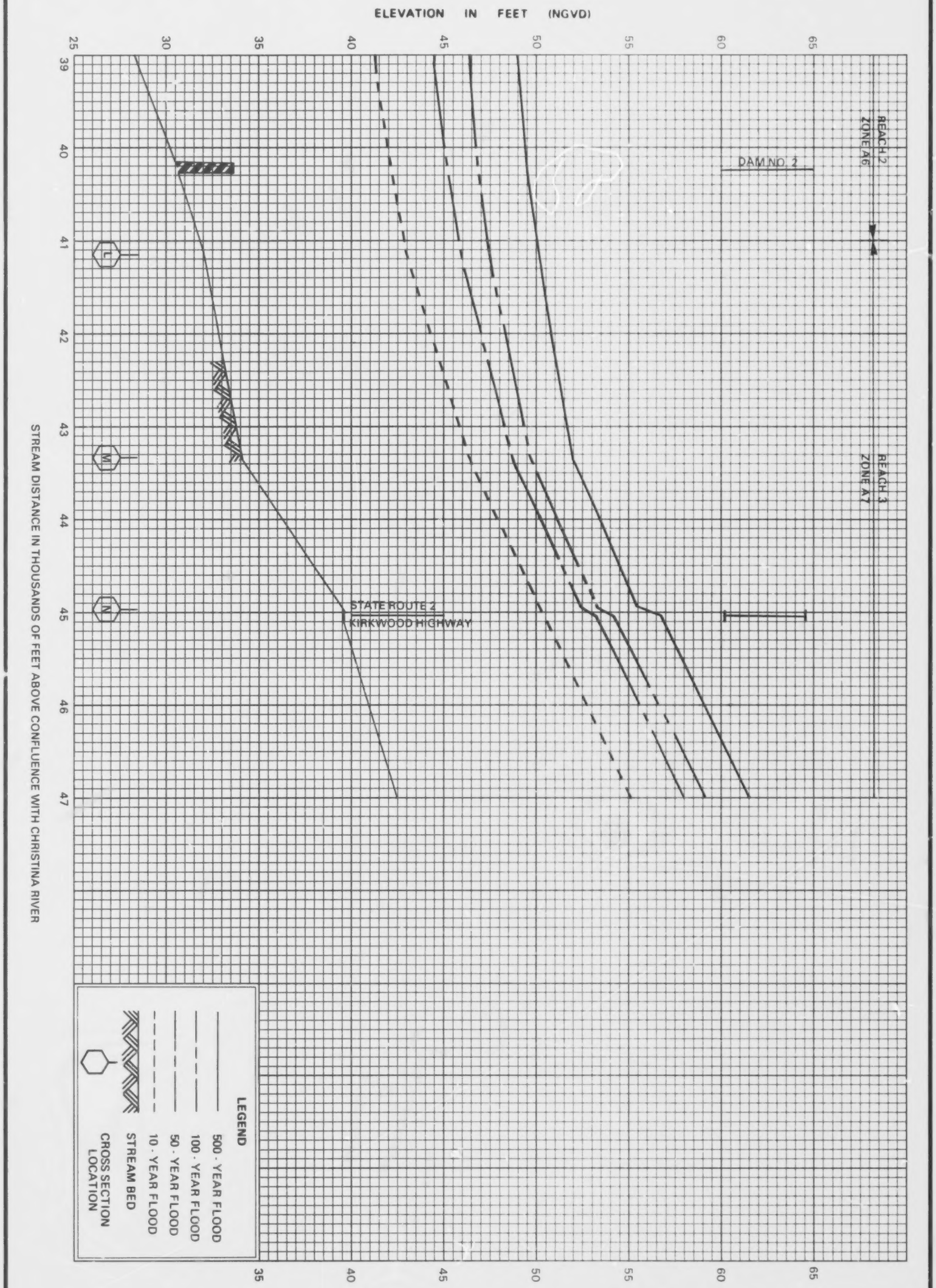

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

WHITE CLAY CREEK

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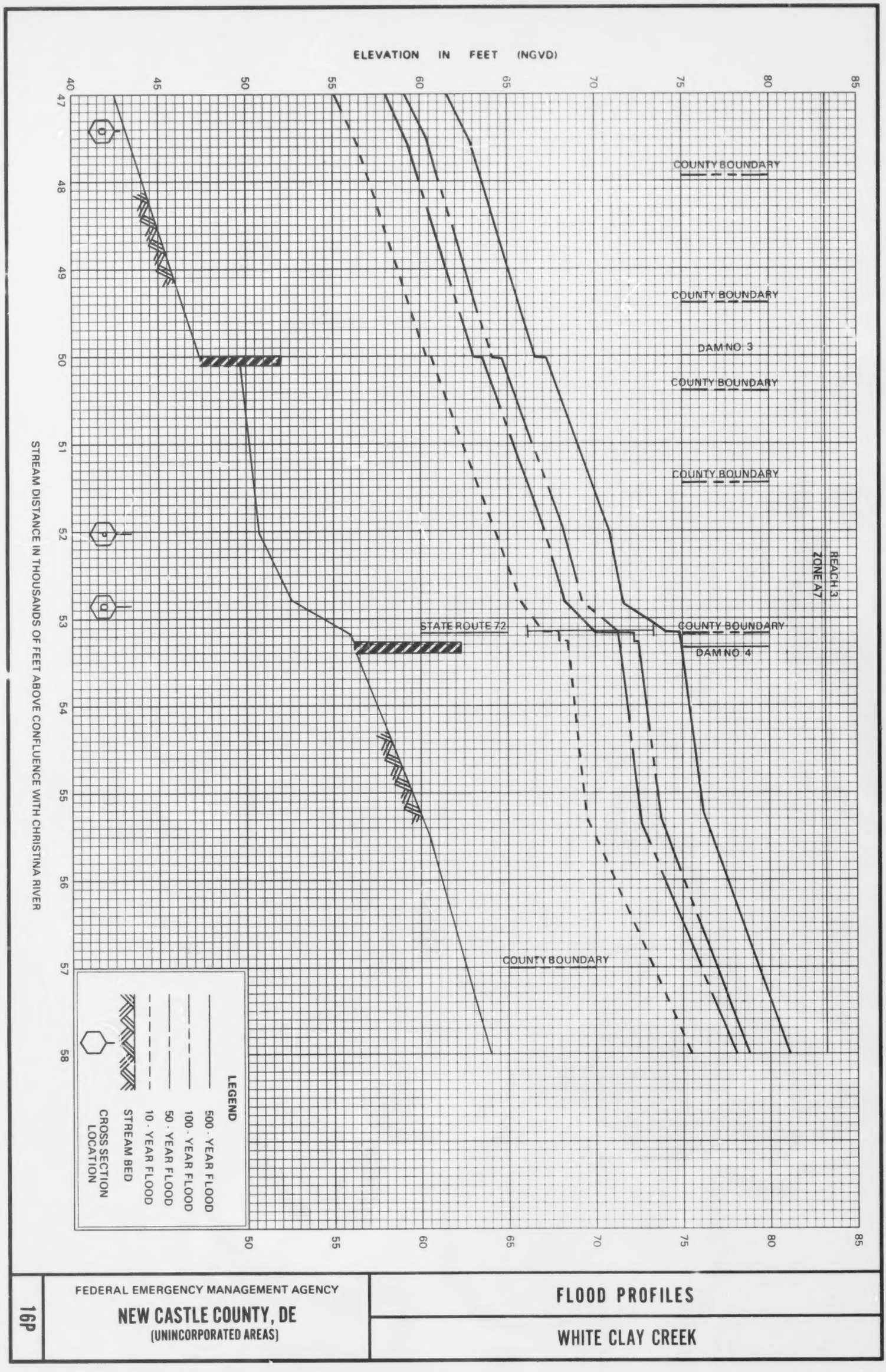

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

WHITE CLAY CREEK

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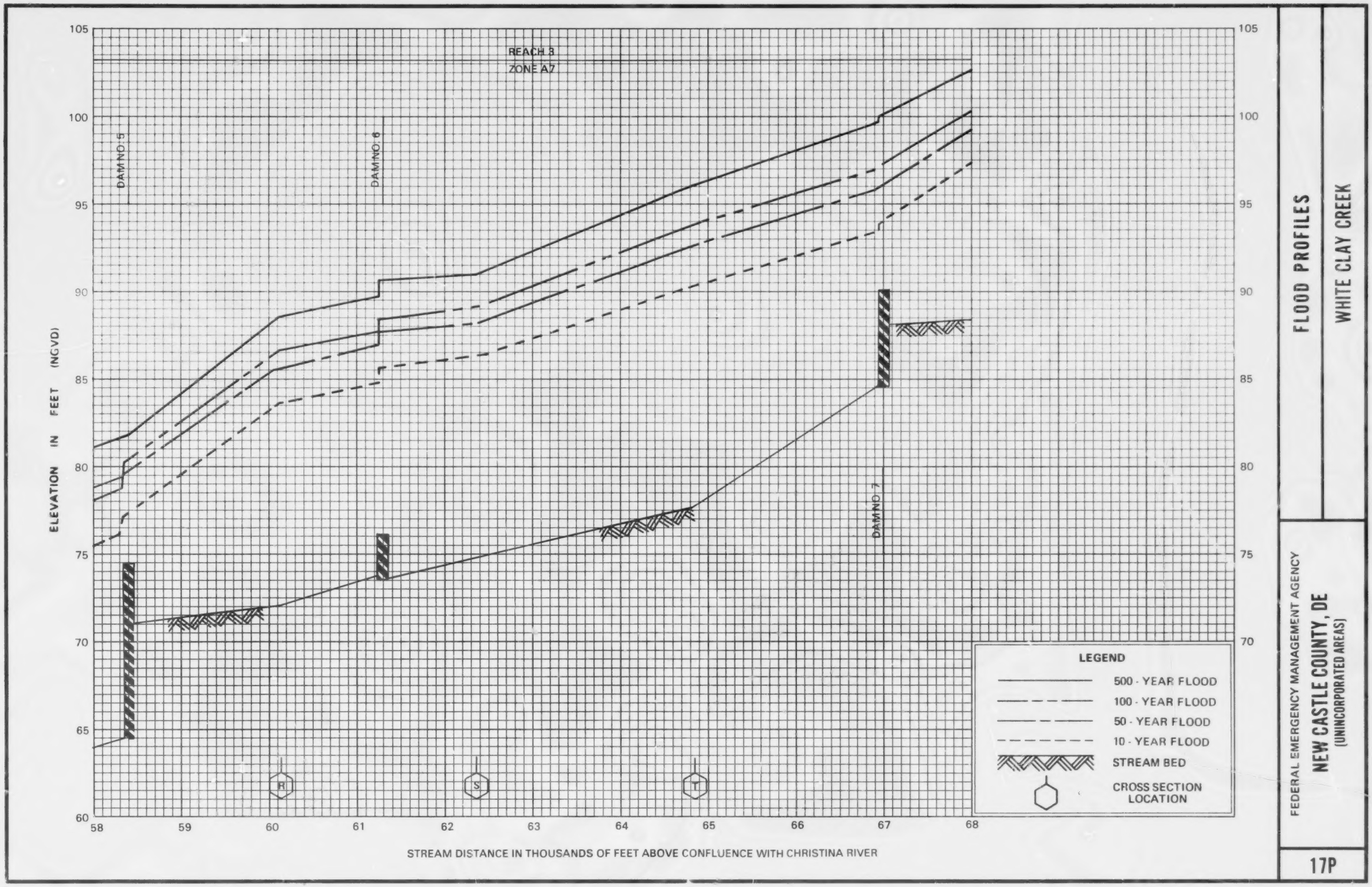

FLOOD PROFILES

WHITE CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

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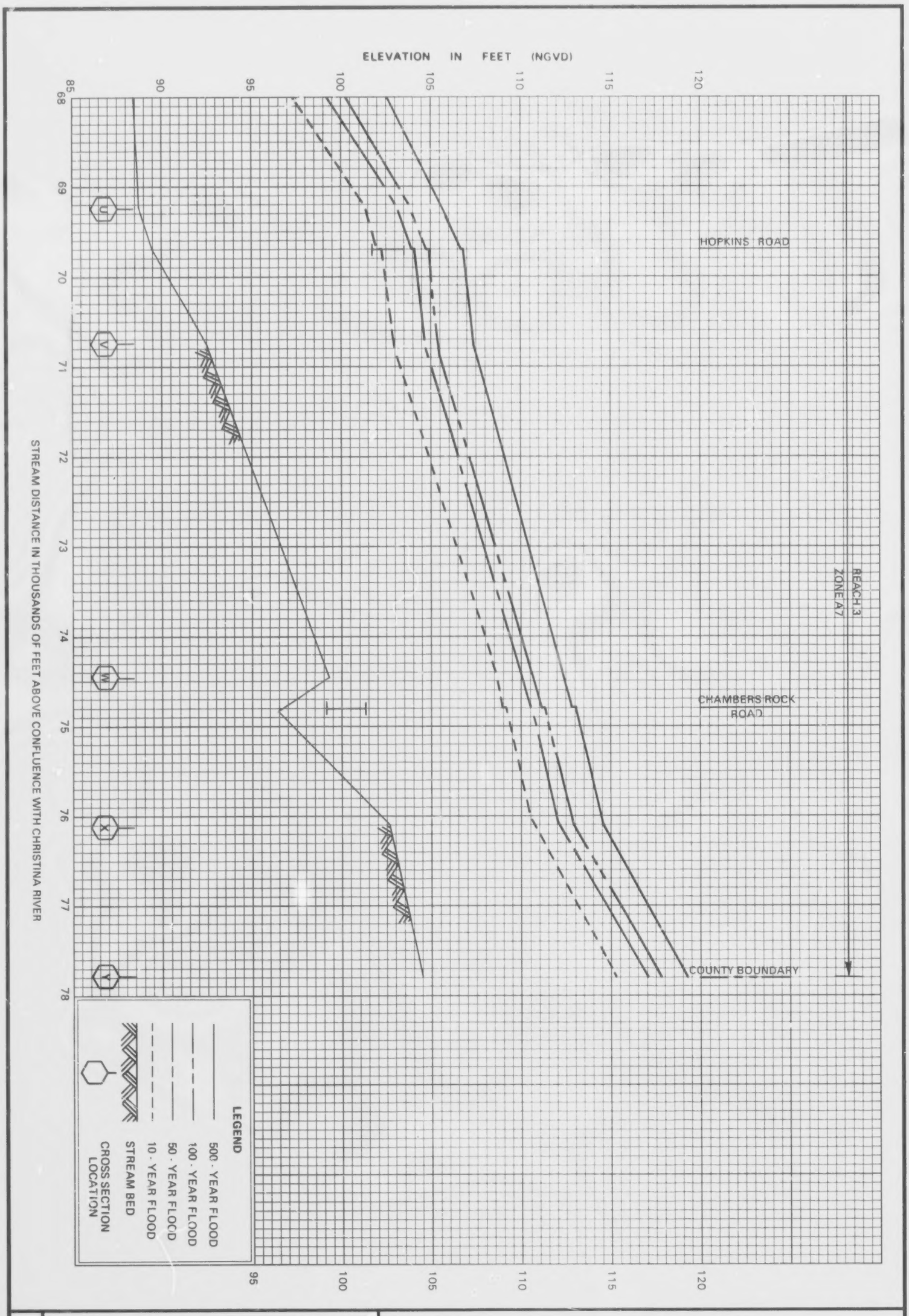

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FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

WHITE CLAY CREEK

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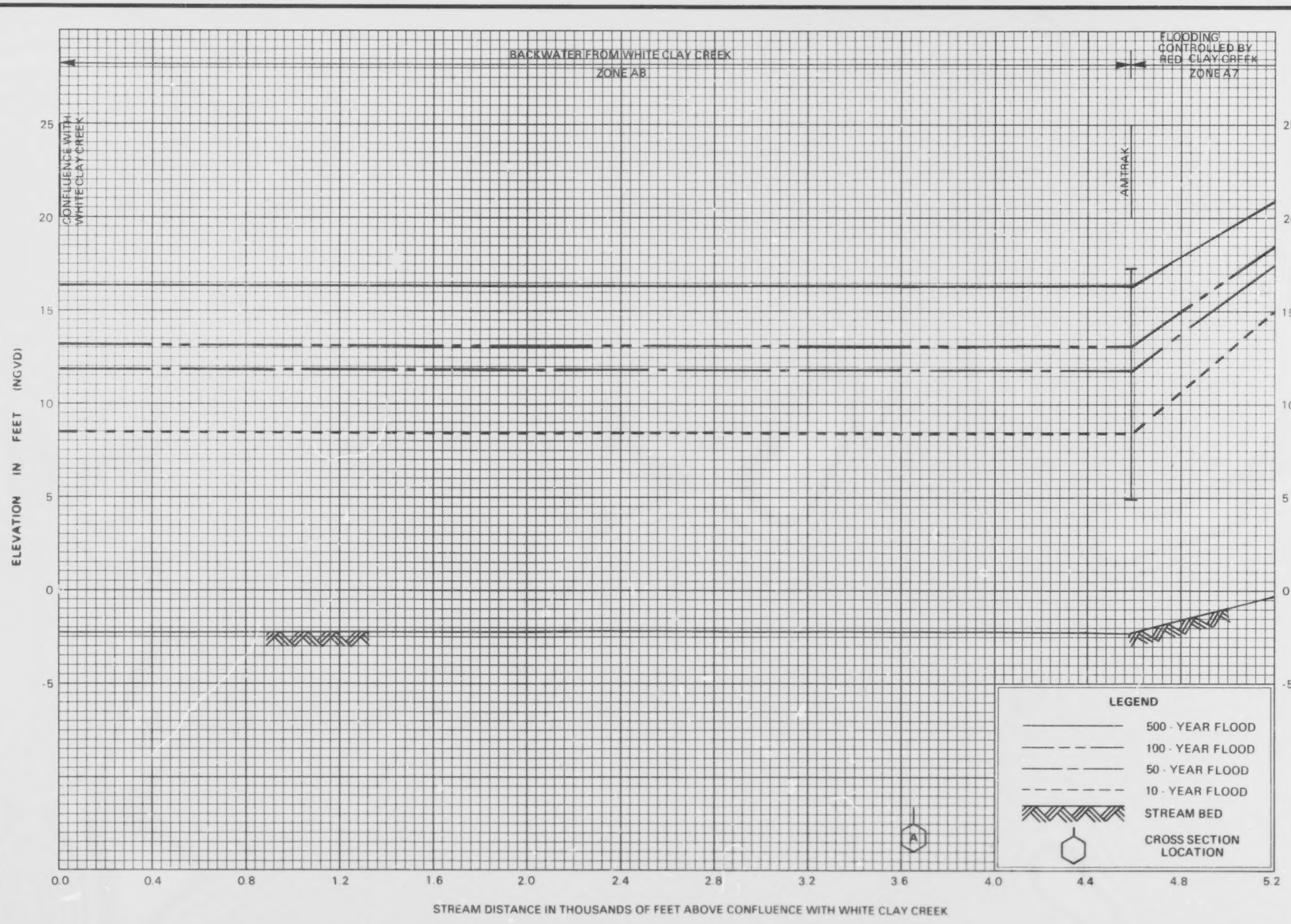

FLOOD PROFILES

TRIBUTARY TO WHITE CLAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

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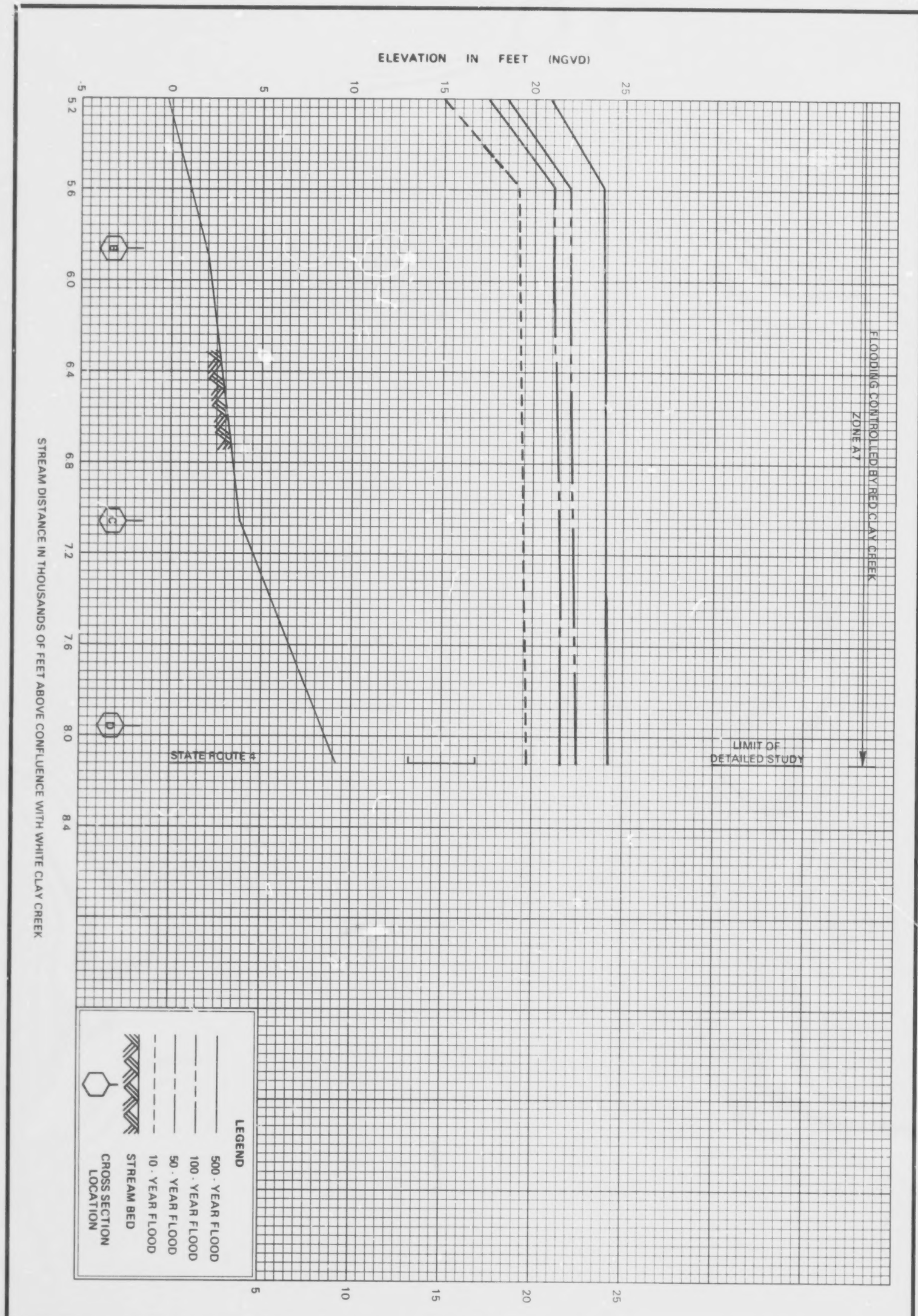
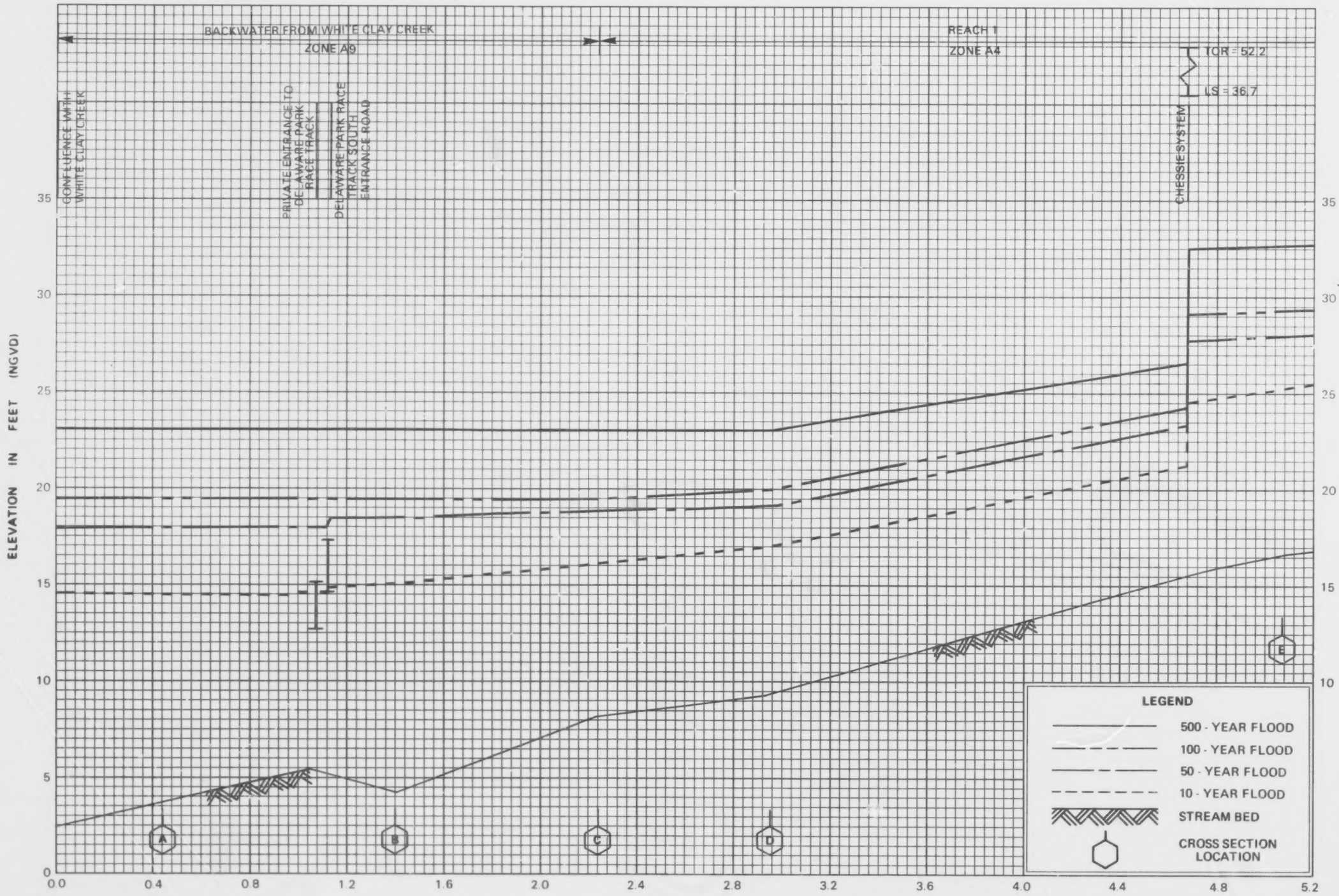


20P	FEDERAL EMERGENCY MANAGEMENT AGENCY **NEW CASTLE COUNTY, DE** (UNINCORPORATED AREAS)	**FLOOD PROFILES** TRIBUTARY TO WHITE CLAY CREEK



FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

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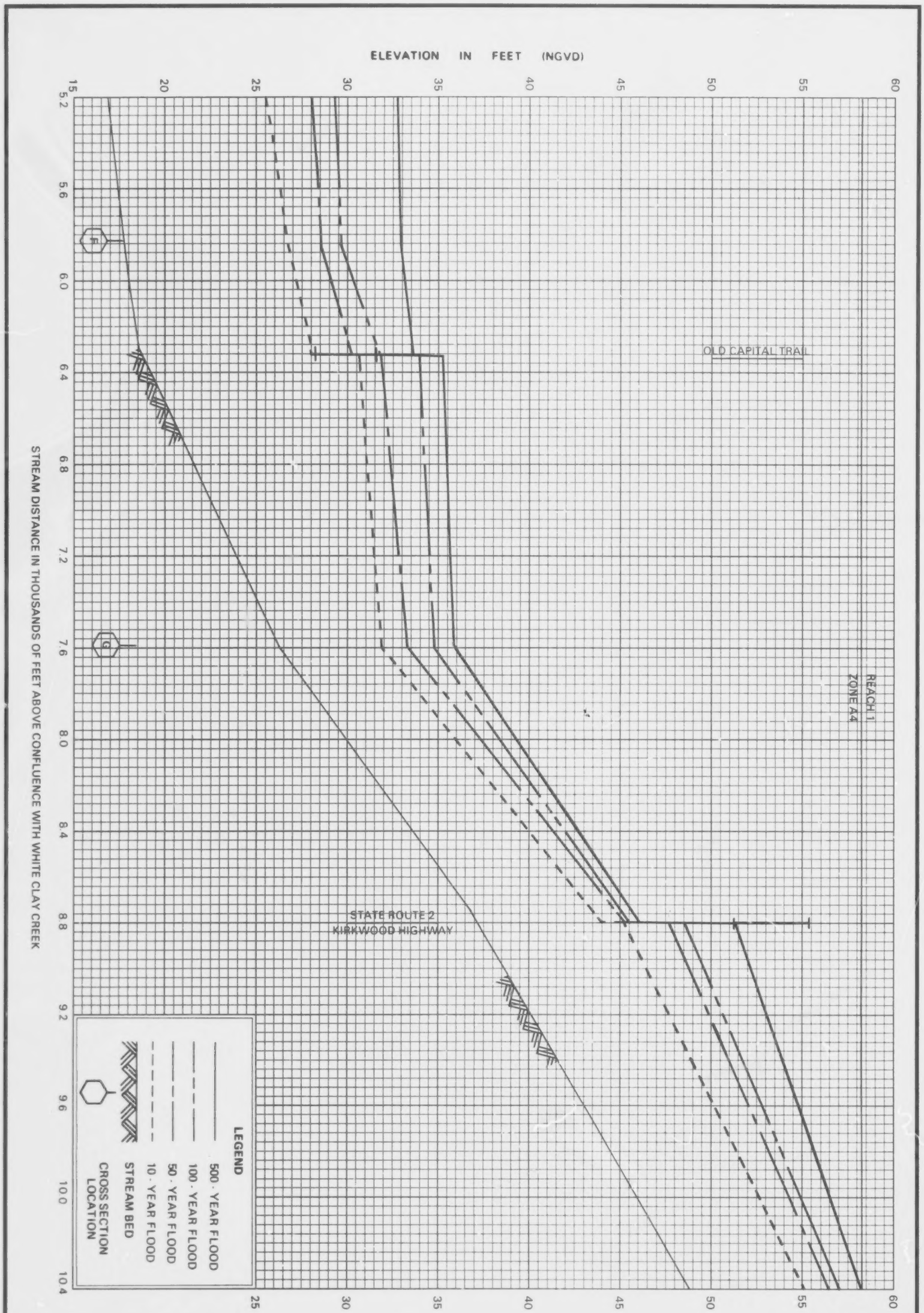

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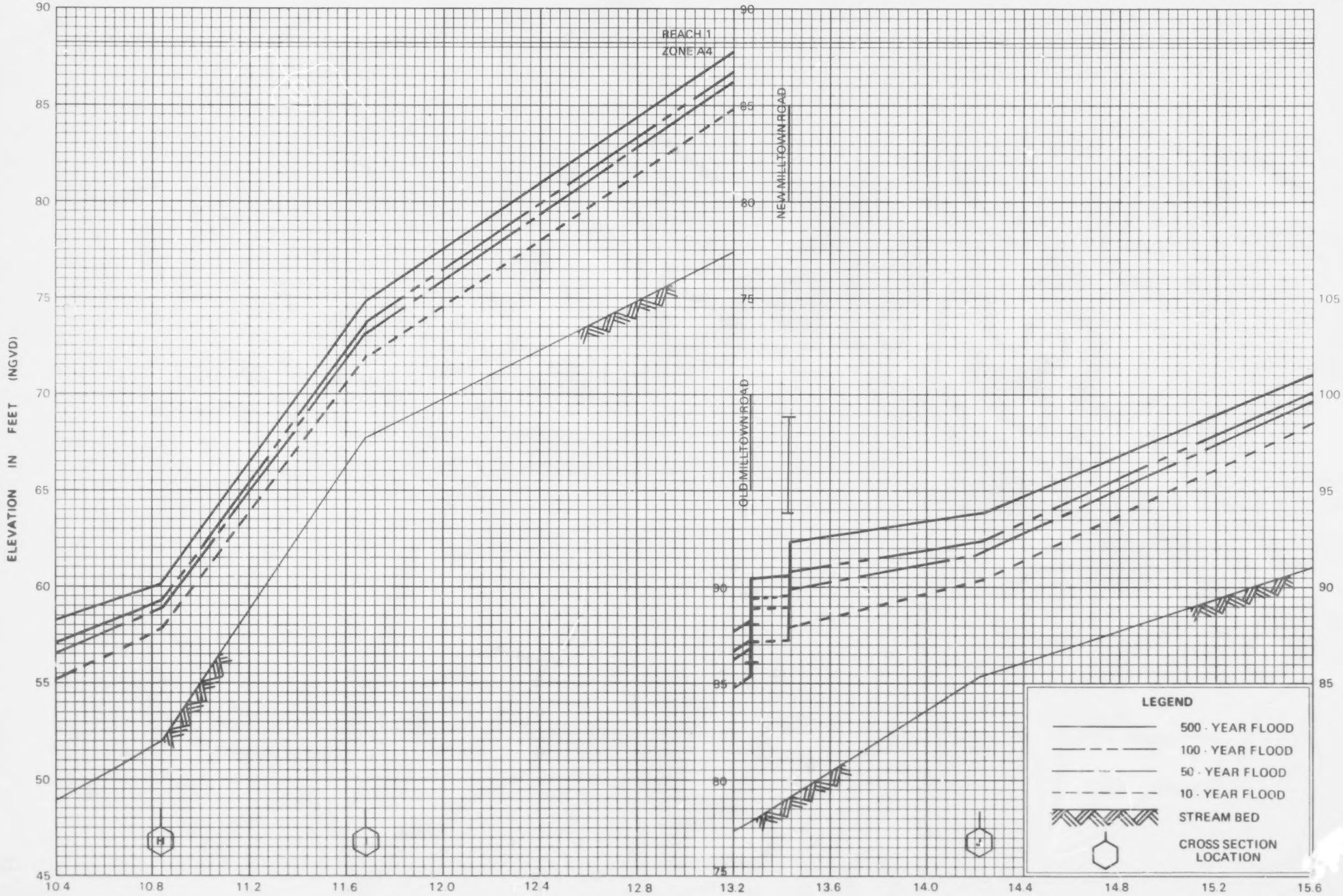
FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

MILL CREEK



FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

23P

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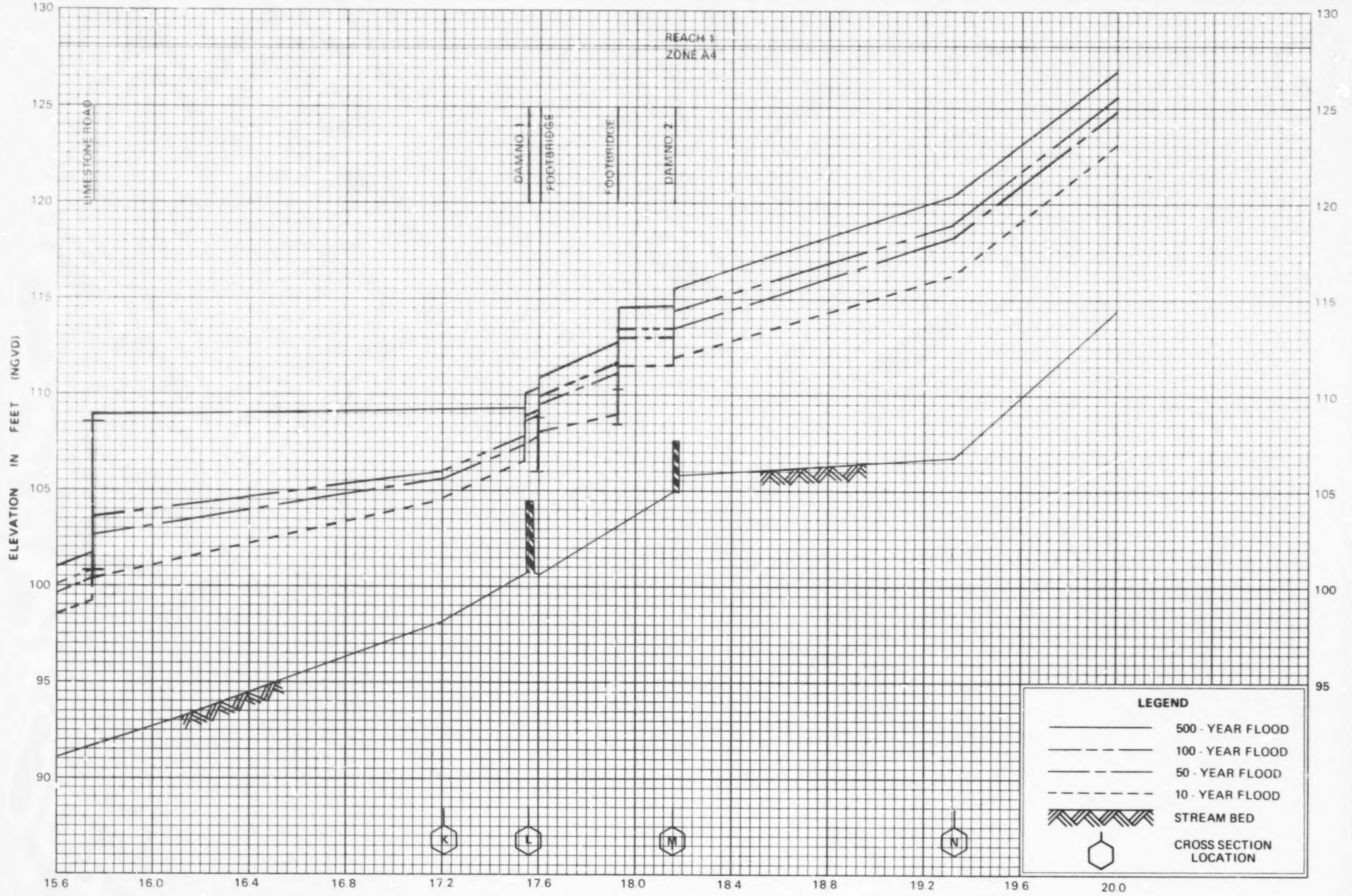

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

24P

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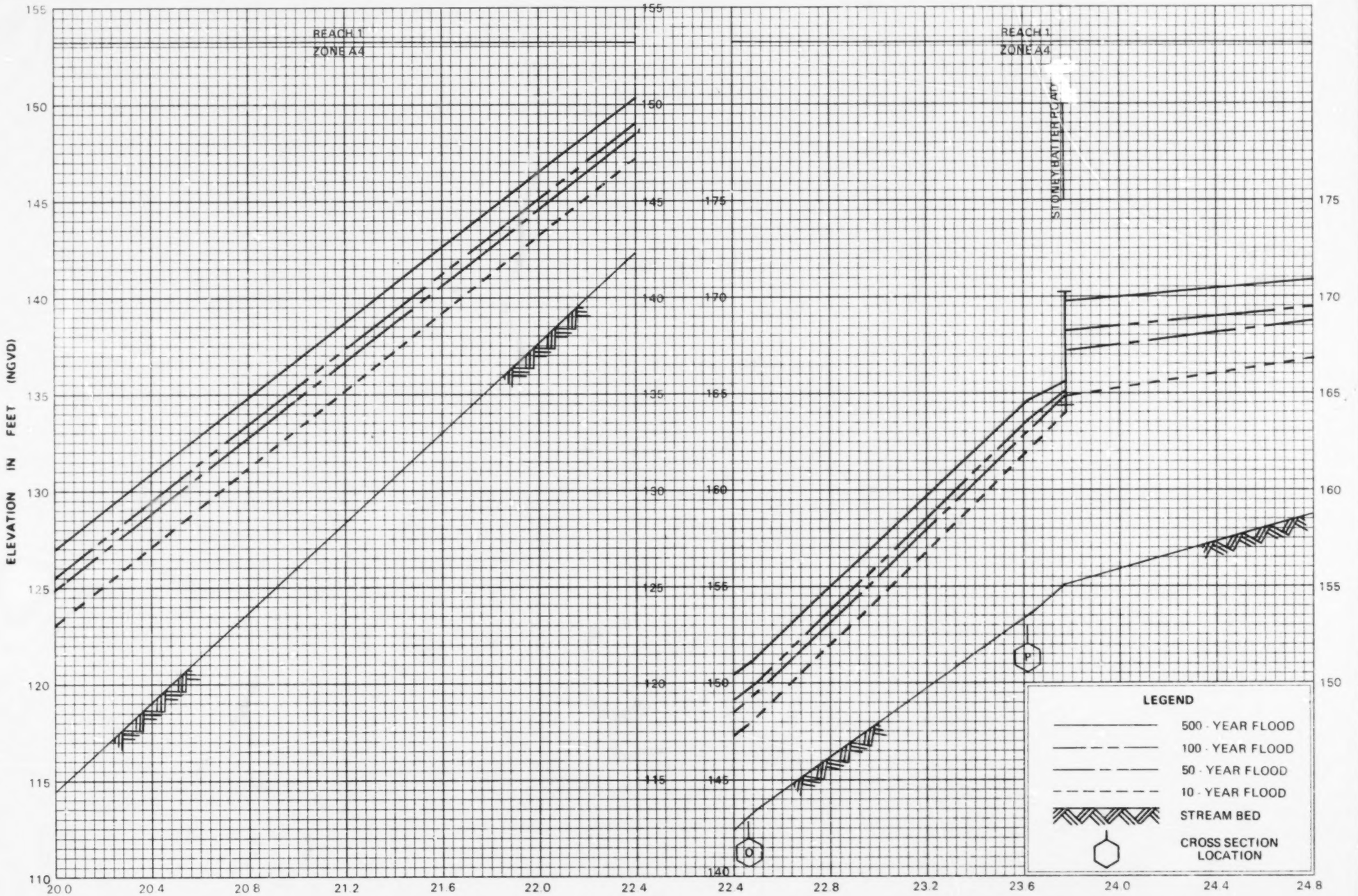

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

25P

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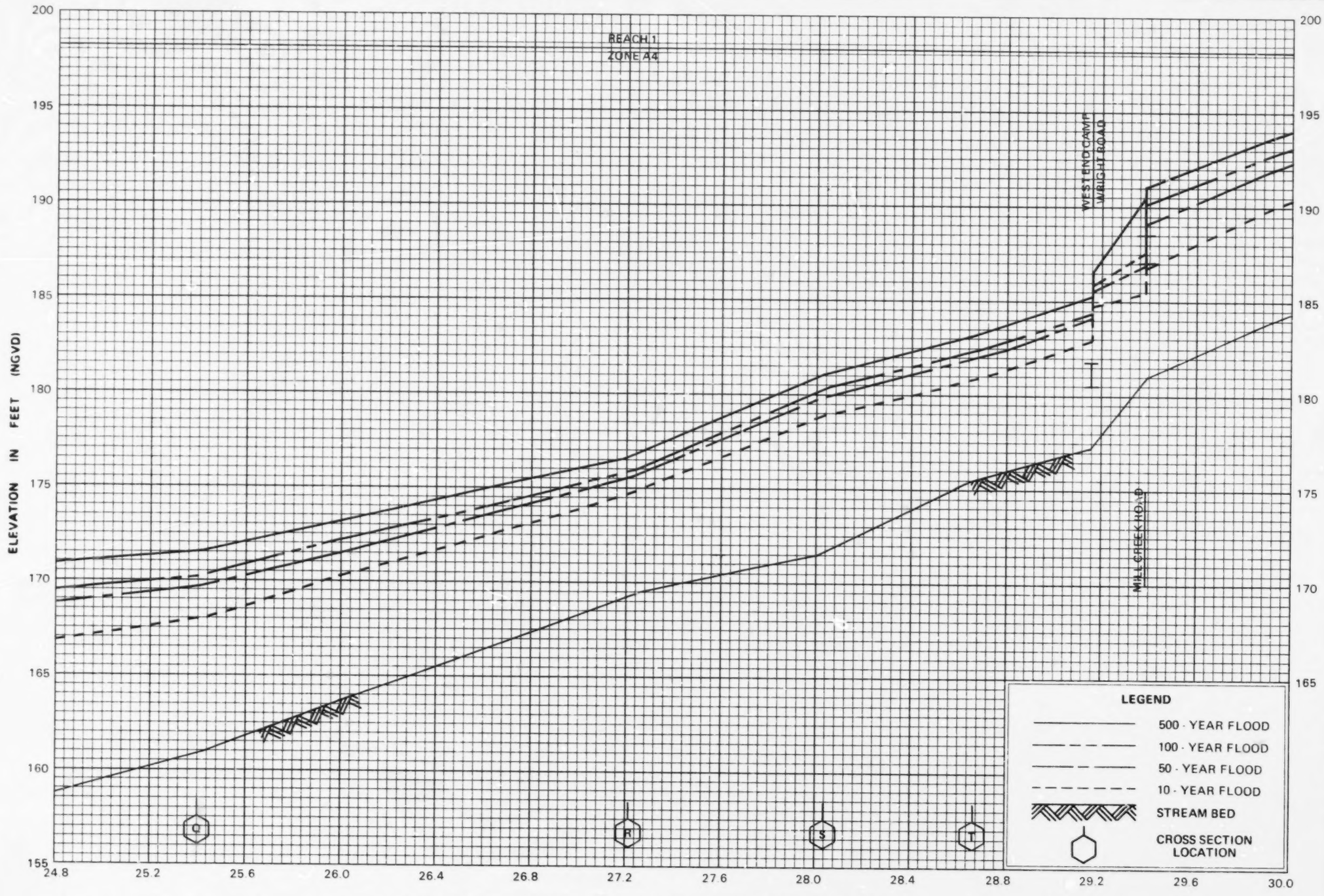

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

26P

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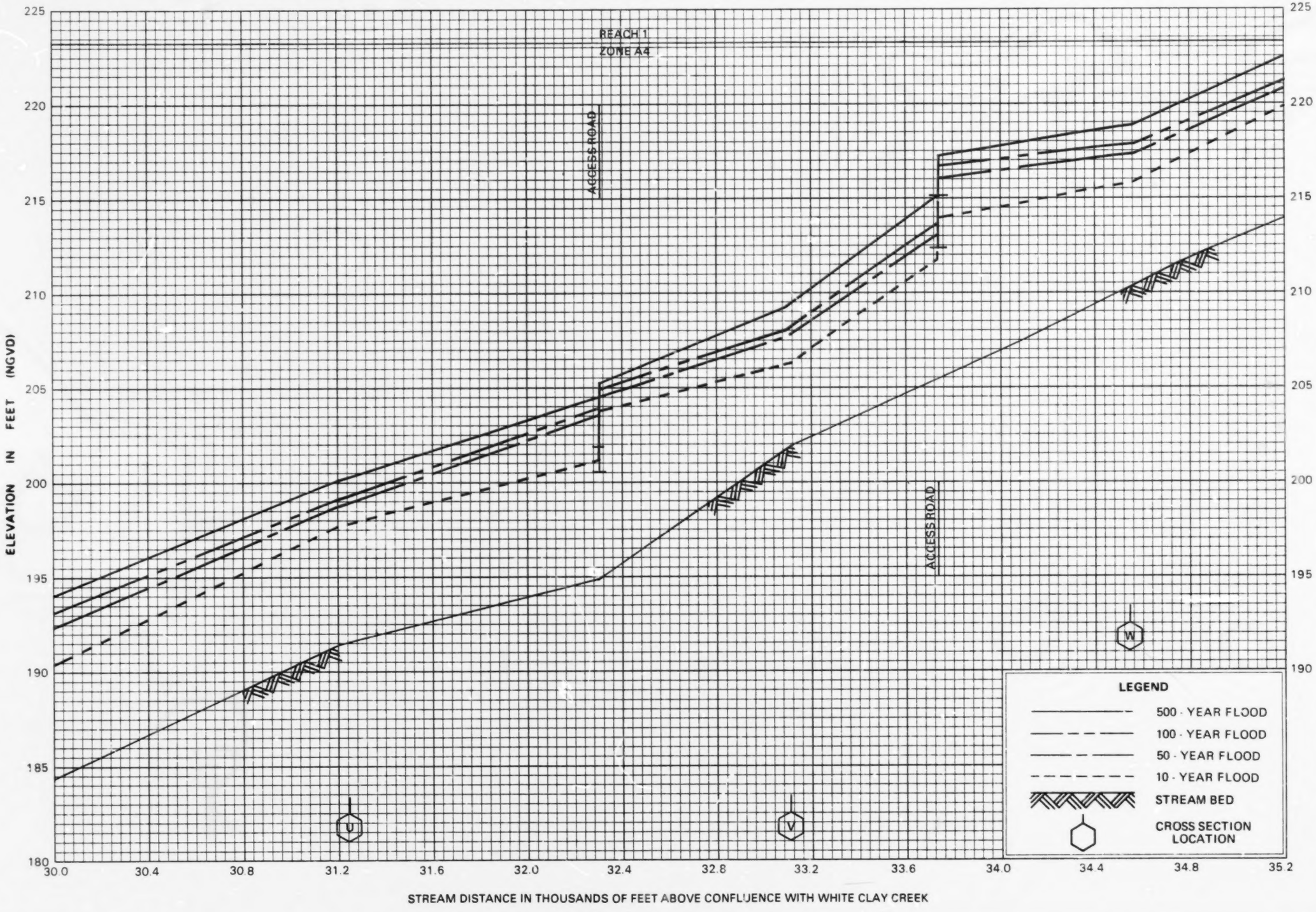

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

27P

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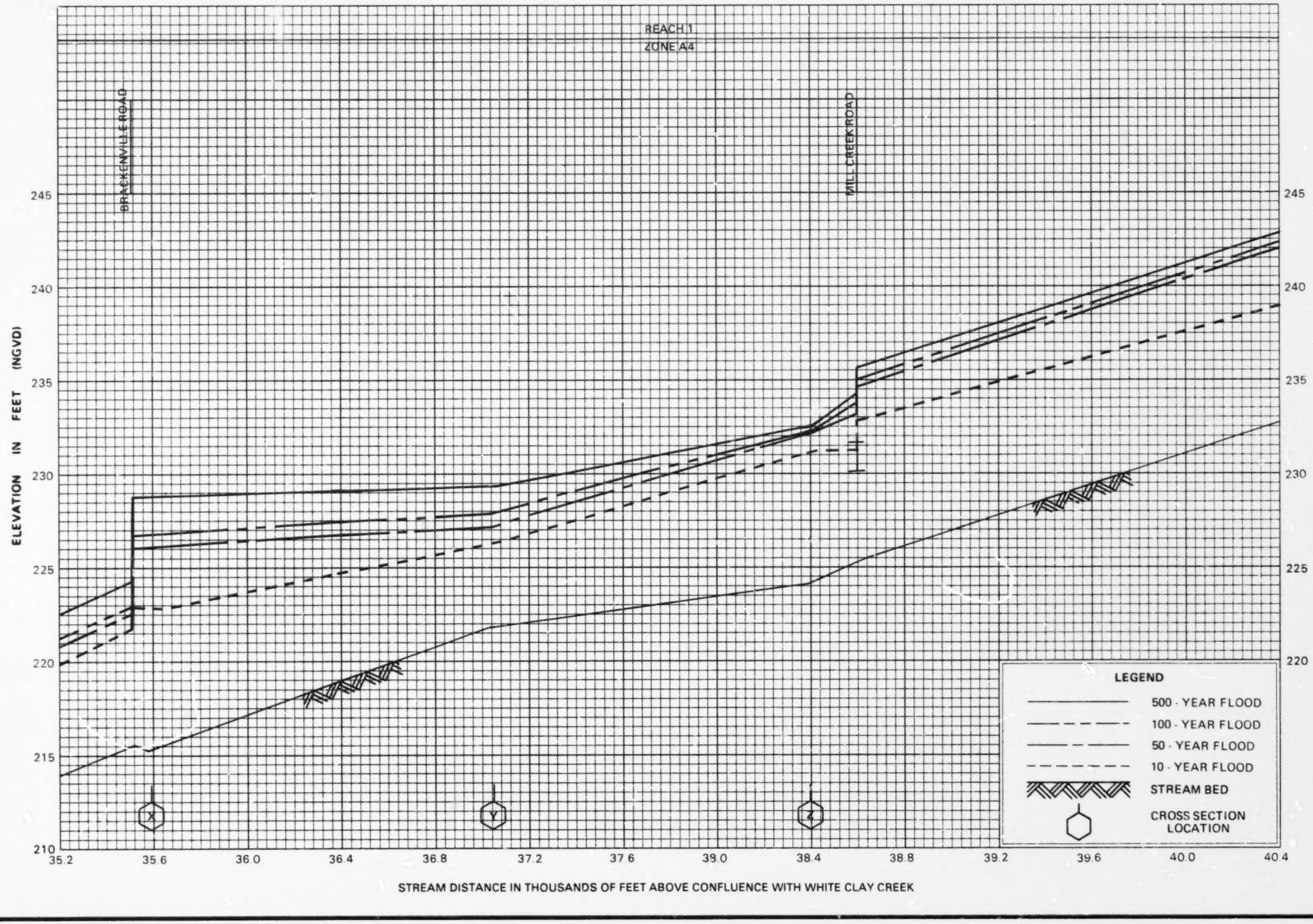

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

28P

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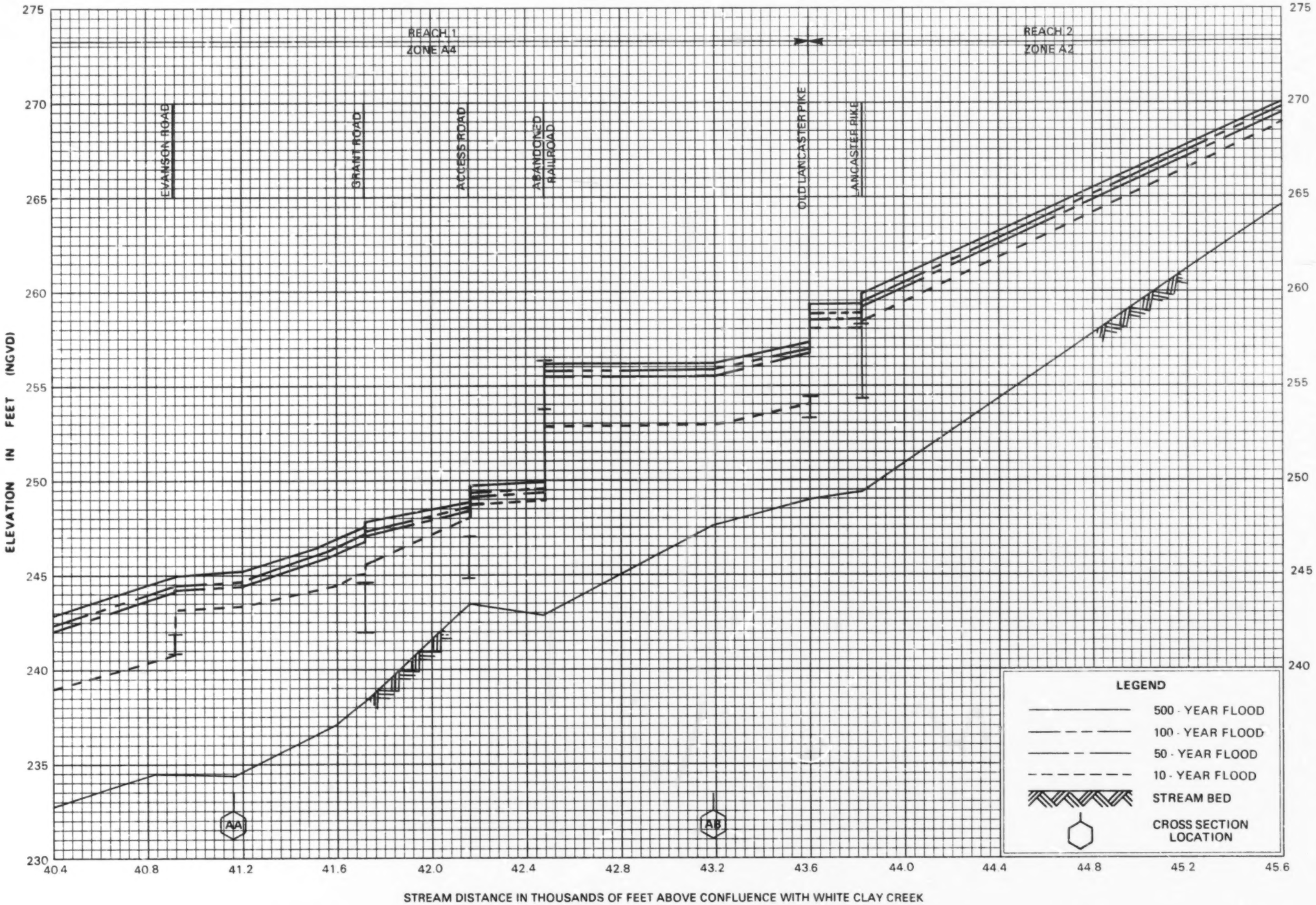

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

29P

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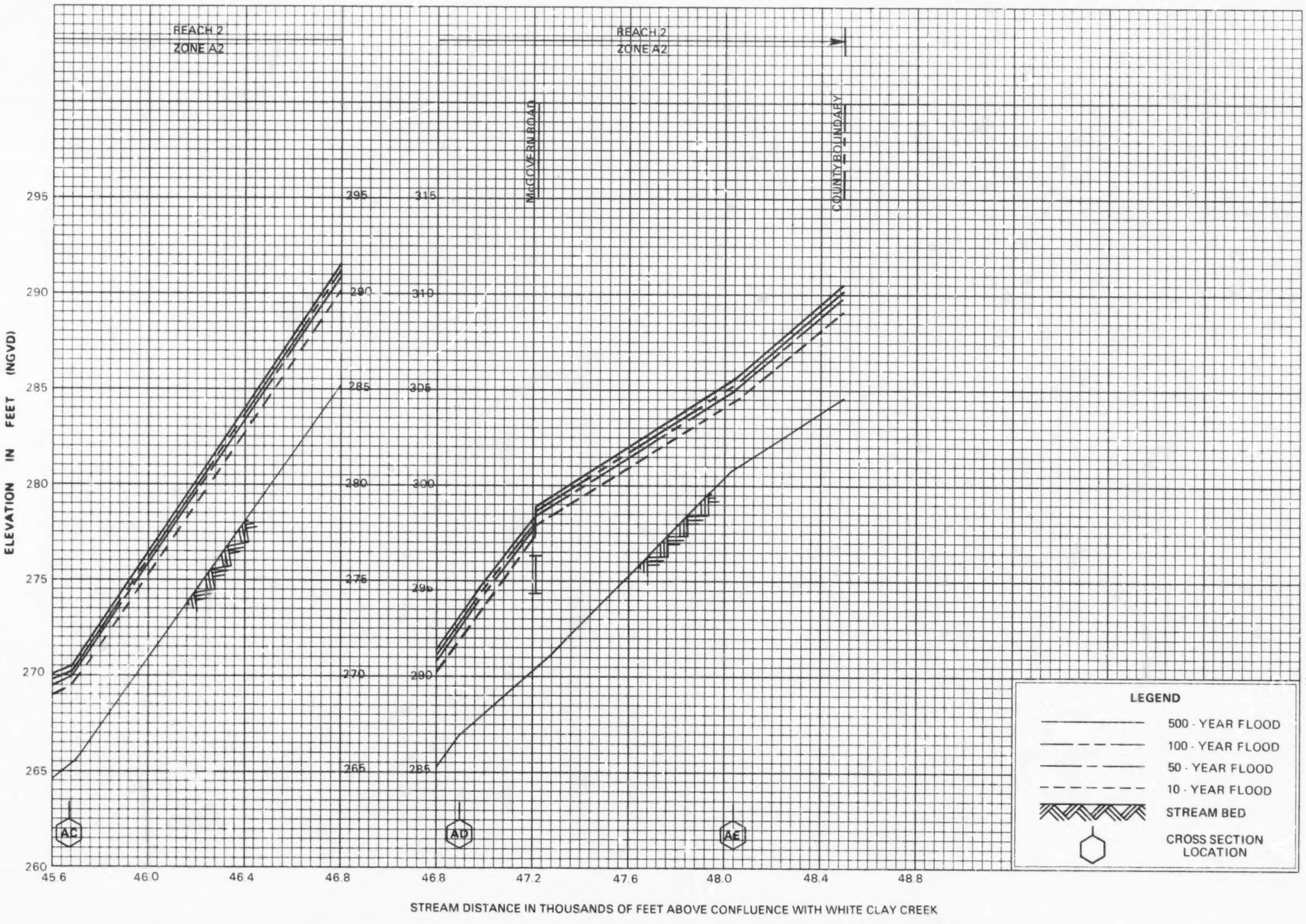

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

30P

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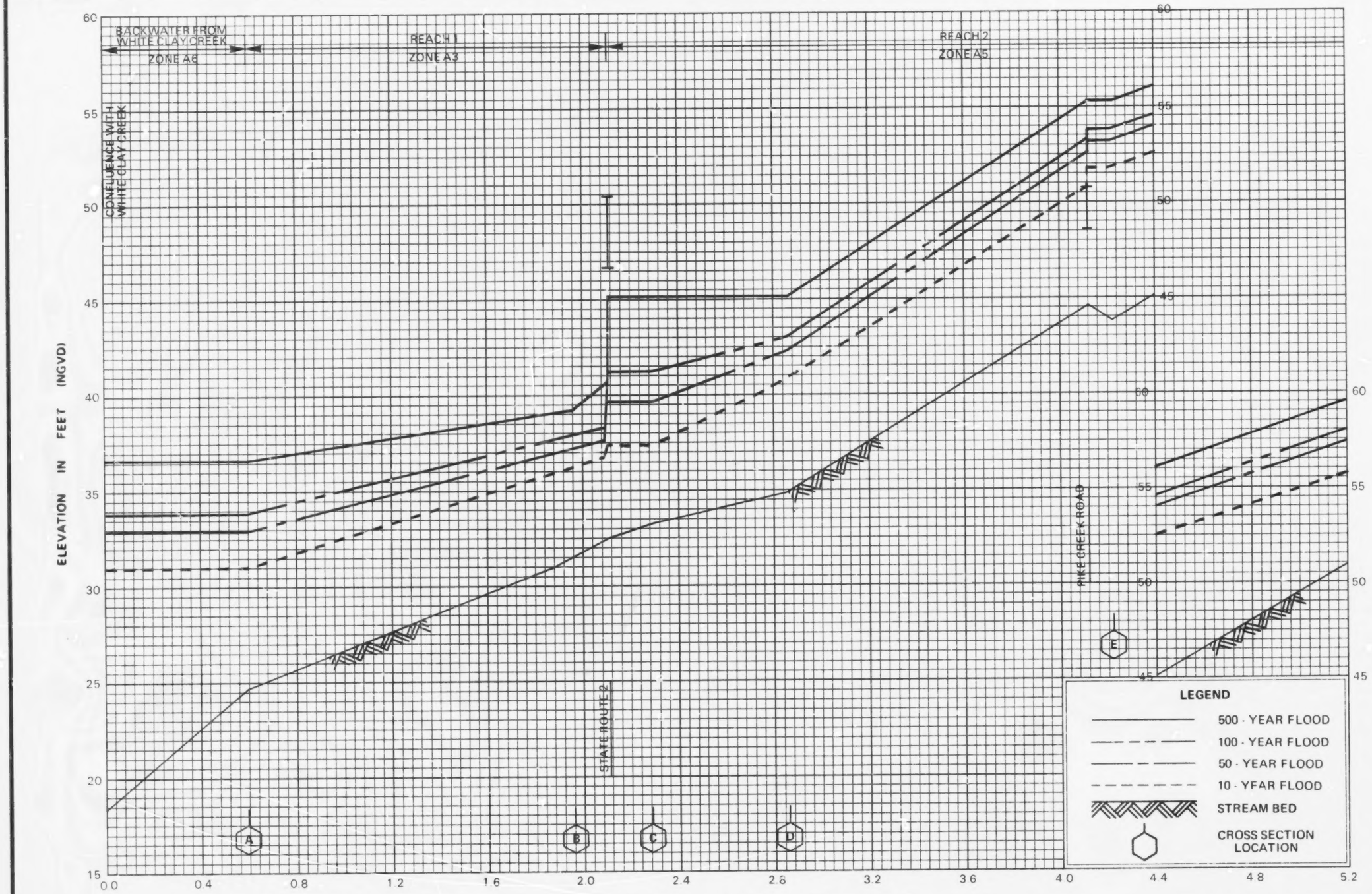

FLOOD PROFILES

PIKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

31P

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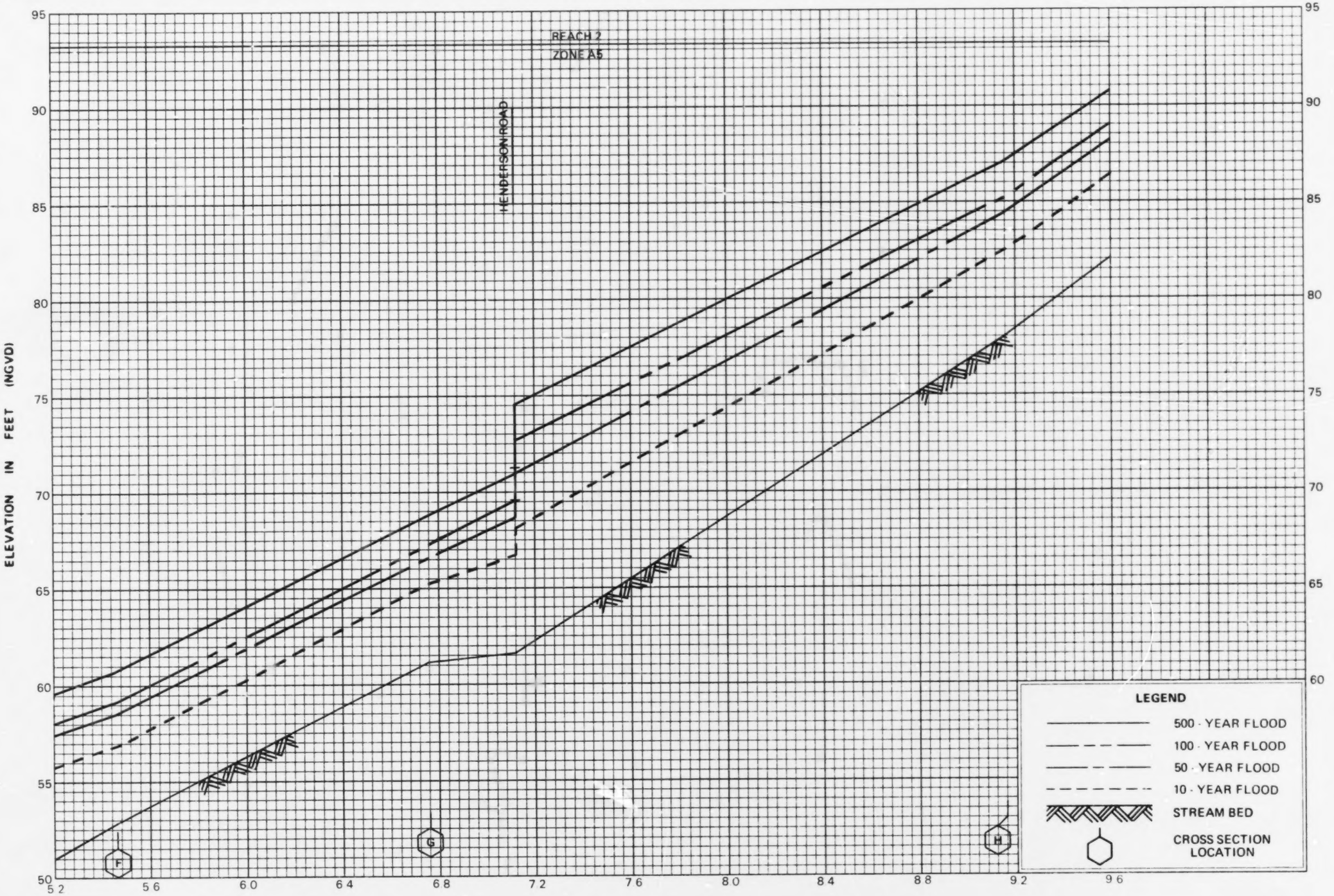

FLOOD PROFILES

PIKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

32P

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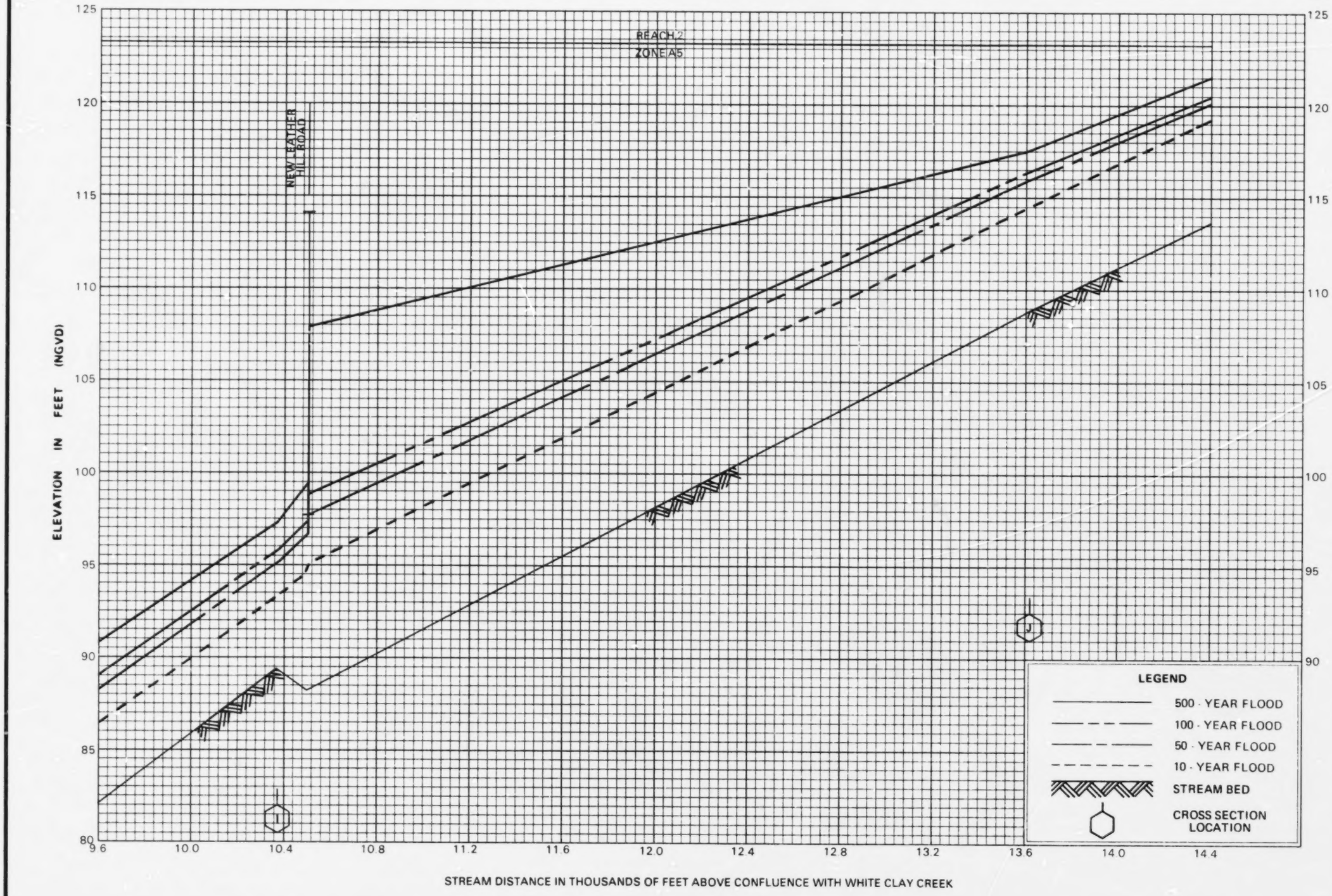

FLOOD PROFILES

PIKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

33P

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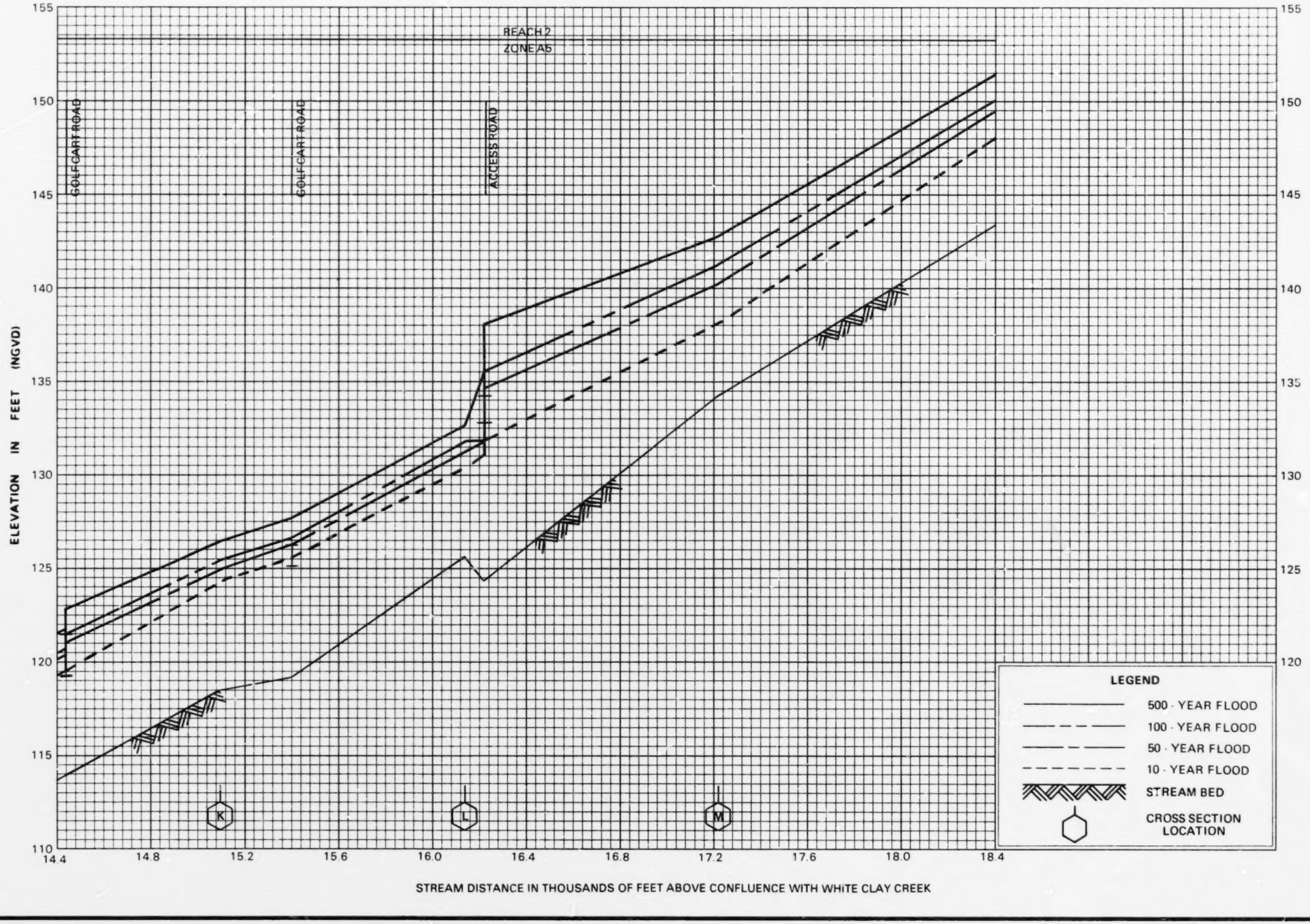

FLOOD PROFILES

PIKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

34P

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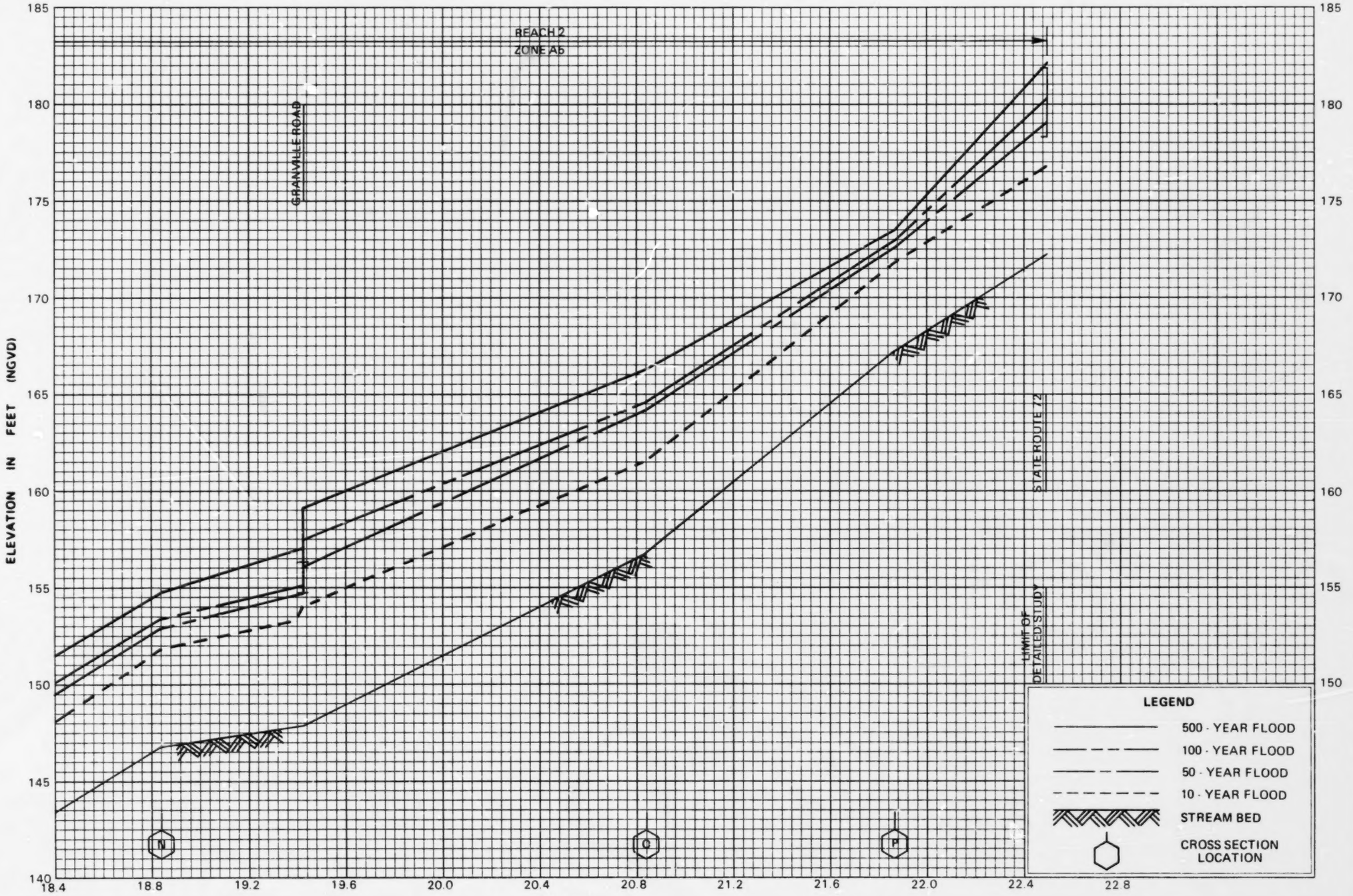

FLOOD PROFILES

PIKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

35P

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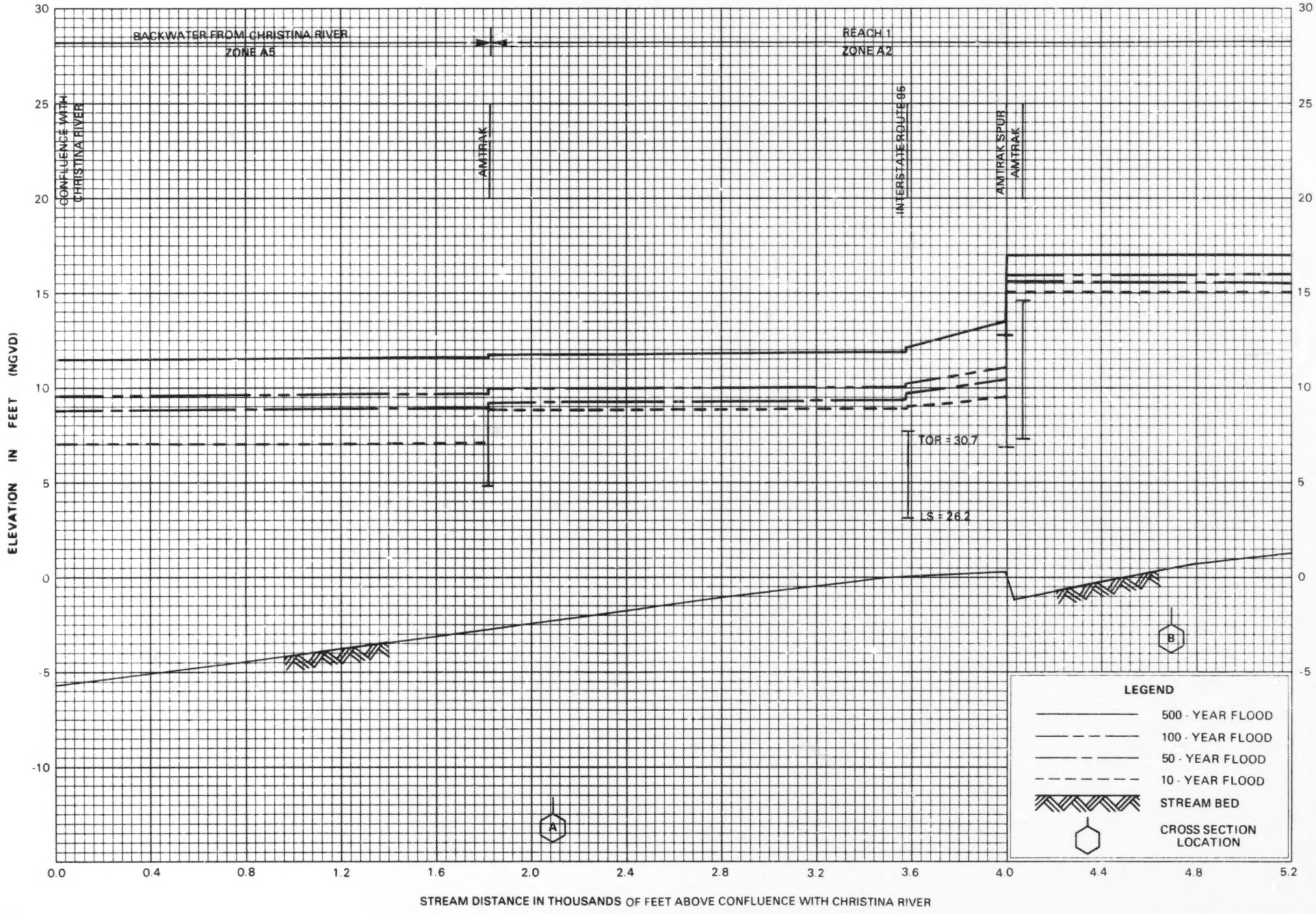

FLOOD PROFILES

LITTLE MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

36P

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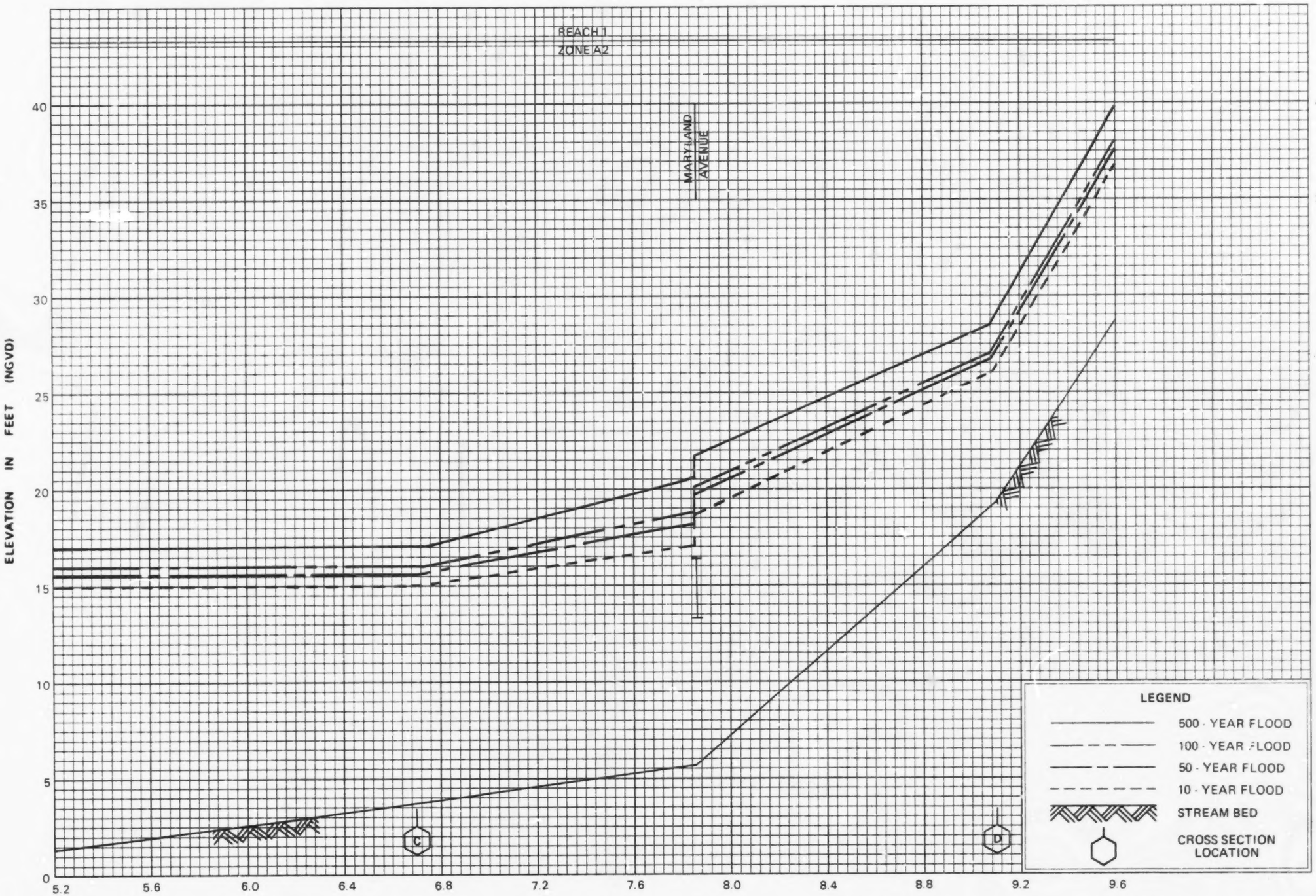

FLOOD PROFILES

LITTLE MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

37P

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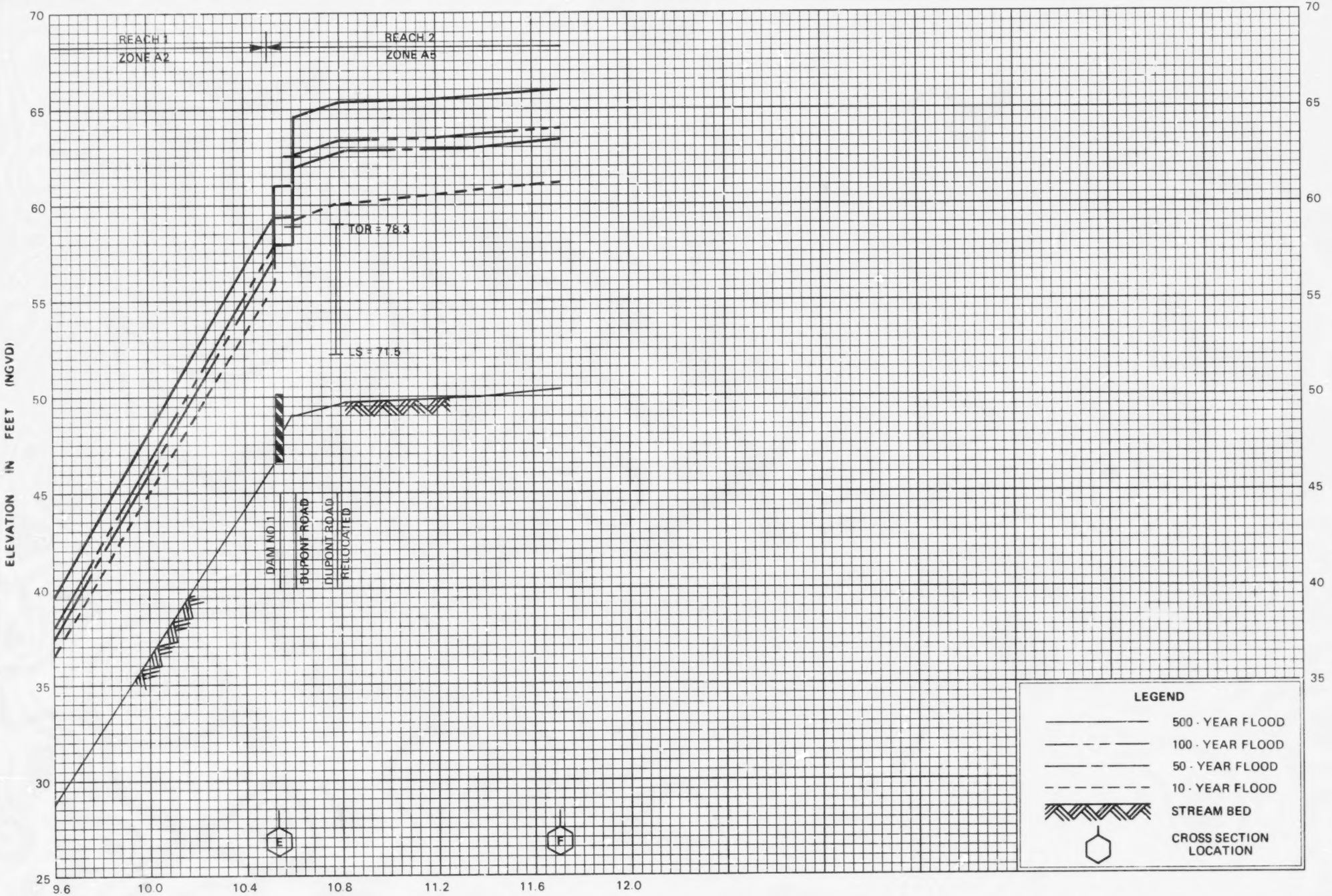

FLOOD PROFILES

LITTLE MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

38P

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REACH 2
ZONE A5

ELEVATION IN FEET (NGVD)

75
70
65
60
55
50
45

11.6 12.0 12.4 12.8 13.2 13.6 14.0 14.4 14.8

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CONFLUENCE WITH CHRISTINA RIVER

LEGEND

- 500 - YEAR FLOOD
- 100 - YEAR FLOOD
- 50 - YEAR FLOOD
- 10 - YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

LITTLE MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

39P

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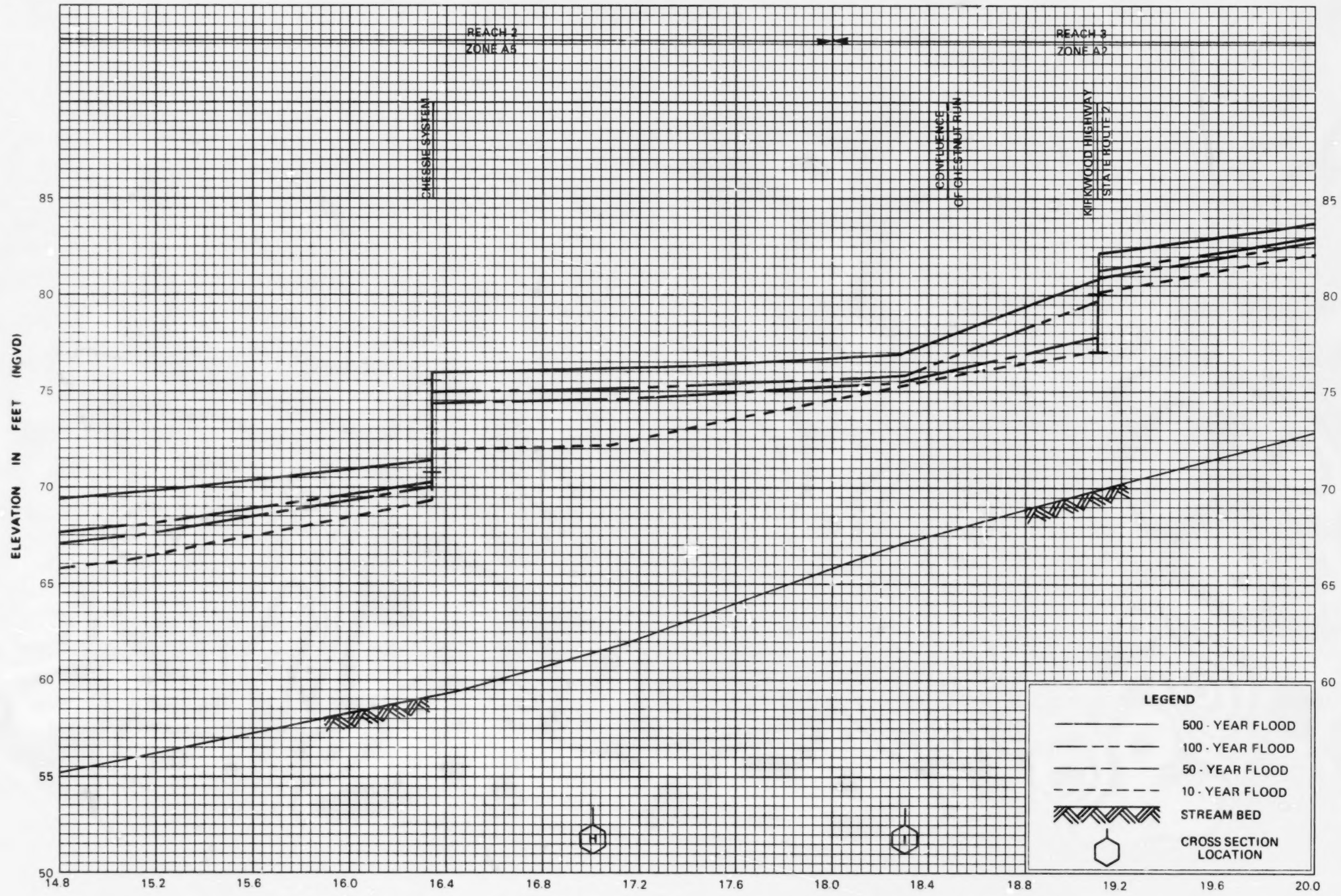

FLOOD PROFILES

LITTLE MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

40P

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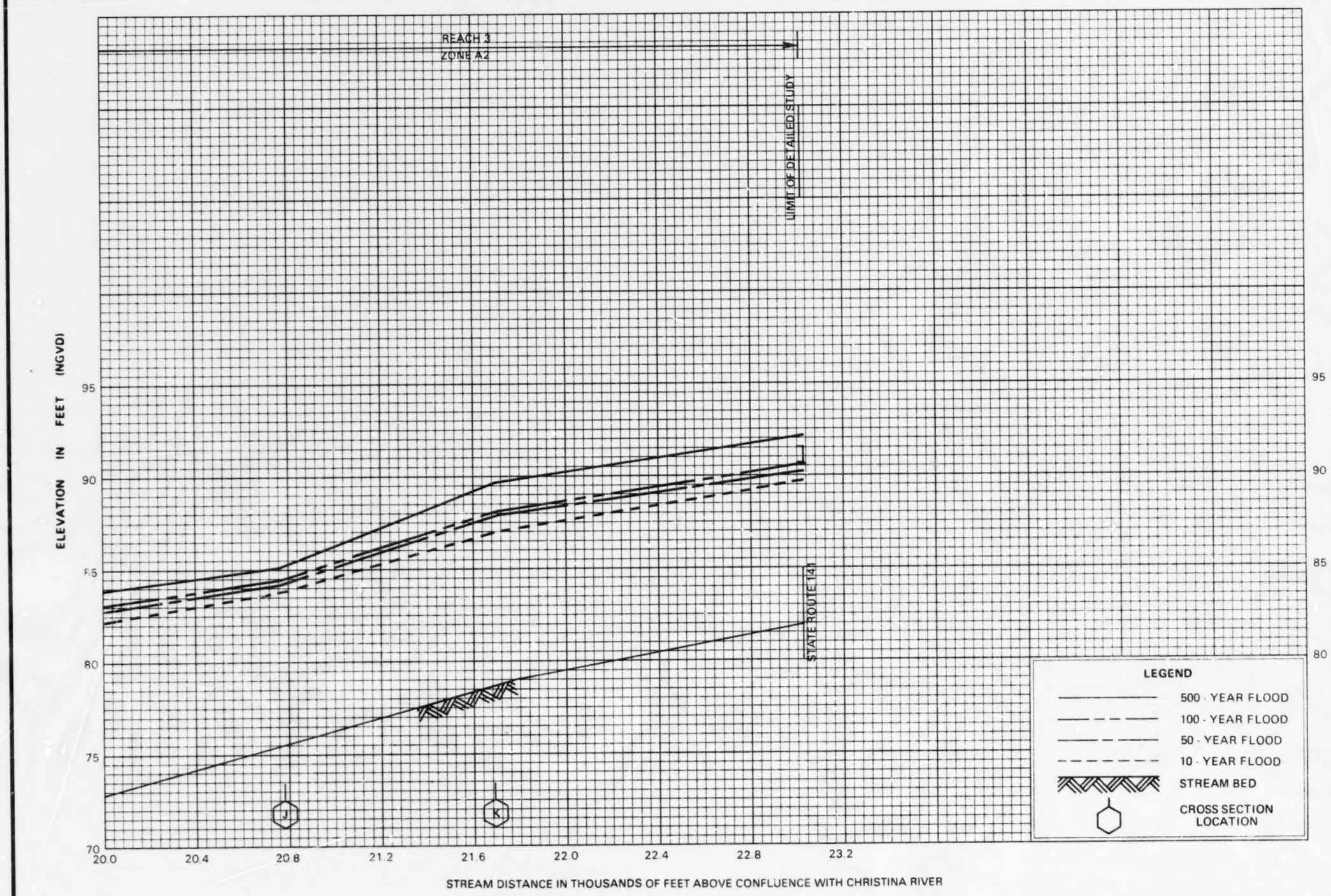

FLOOD PROFILES

LITTLE MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

41P

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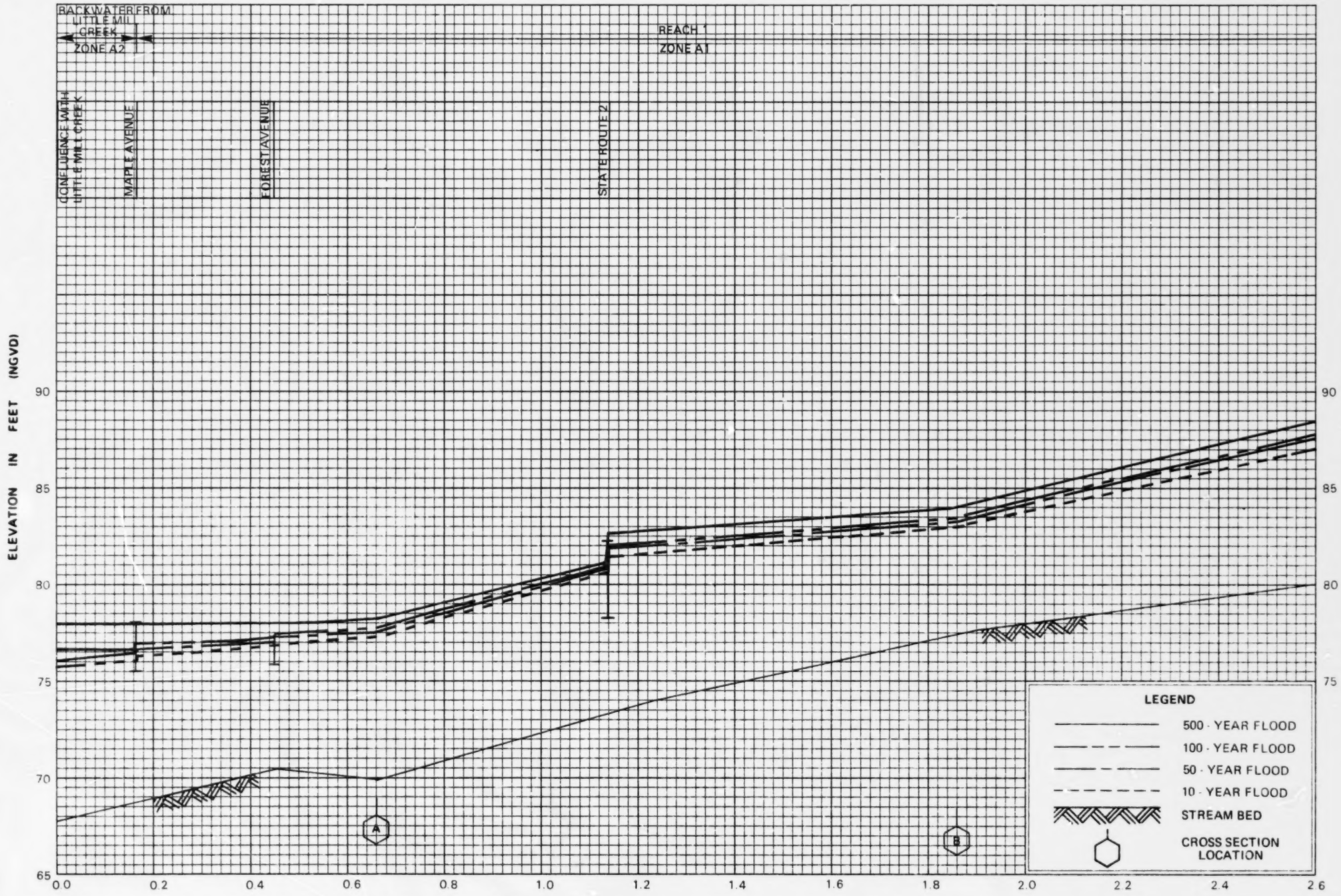

FLOOD PROFILES

CHESTNUT RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

42P

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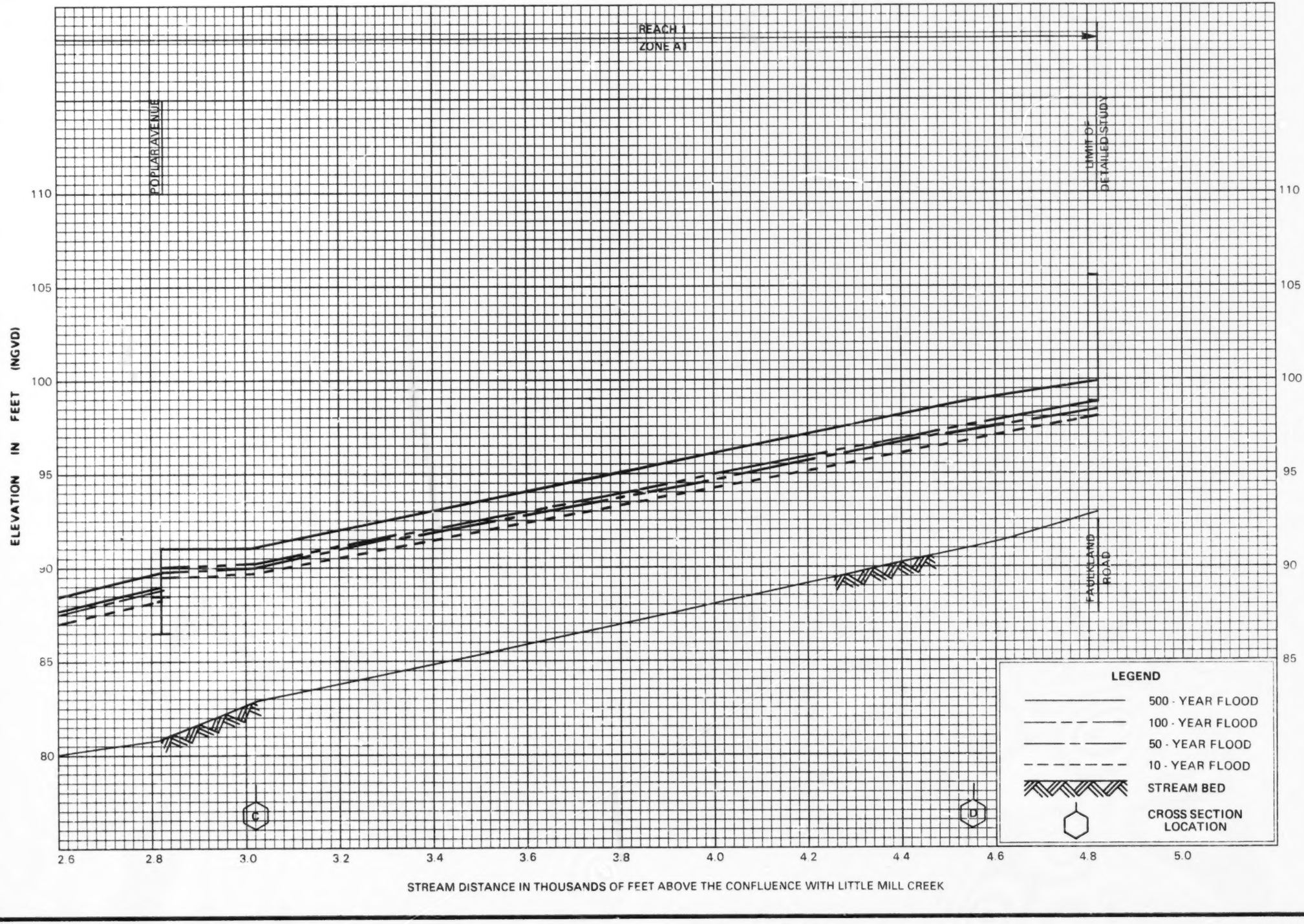

FLOOD PROFILES

CHESTNUT RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

43P

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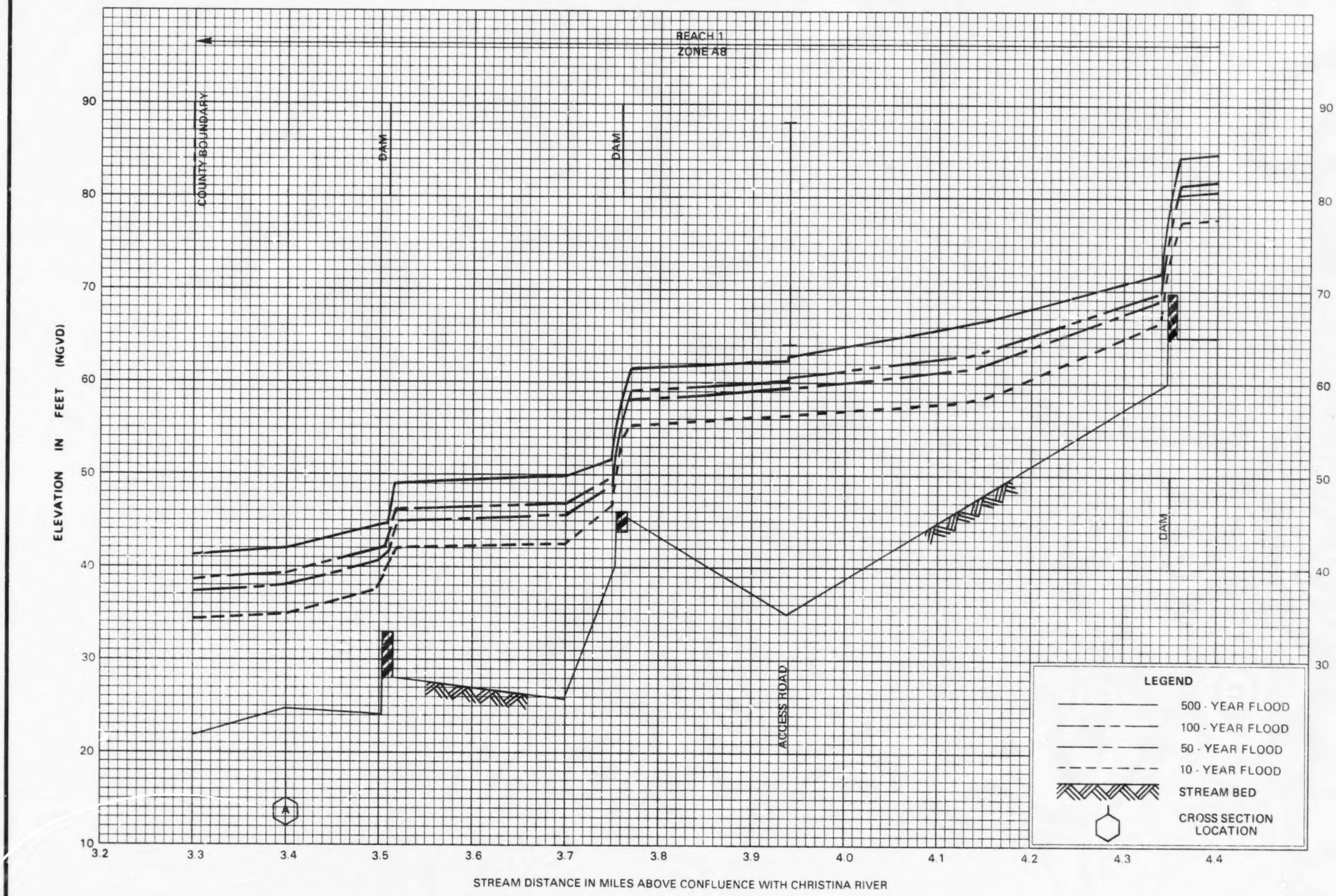

FLOOD PROFILES

BRANDYWINE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE

(UNINCORPORATED AREAS)

44P

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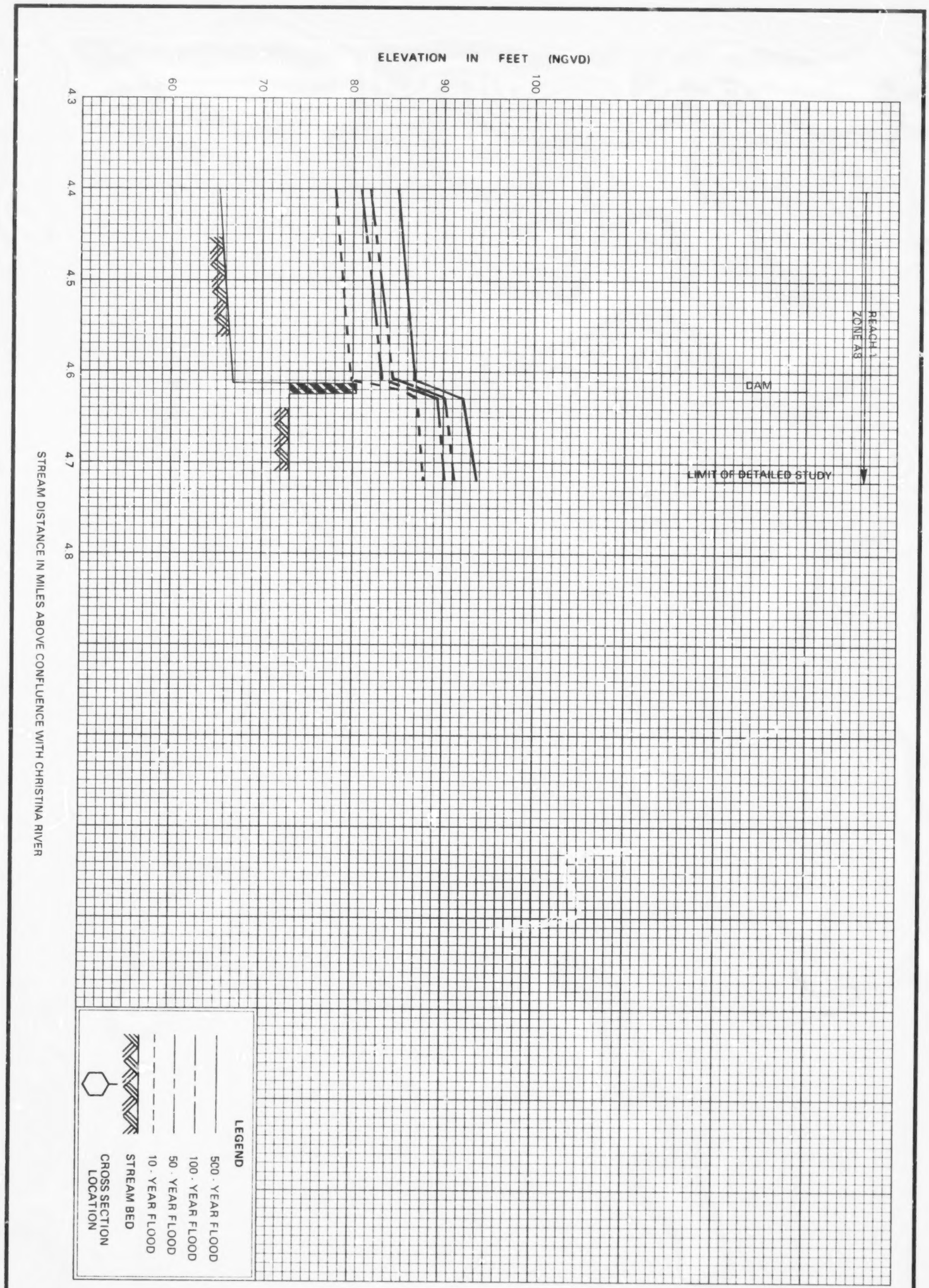

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

BRANDYWINE CREEK

45P

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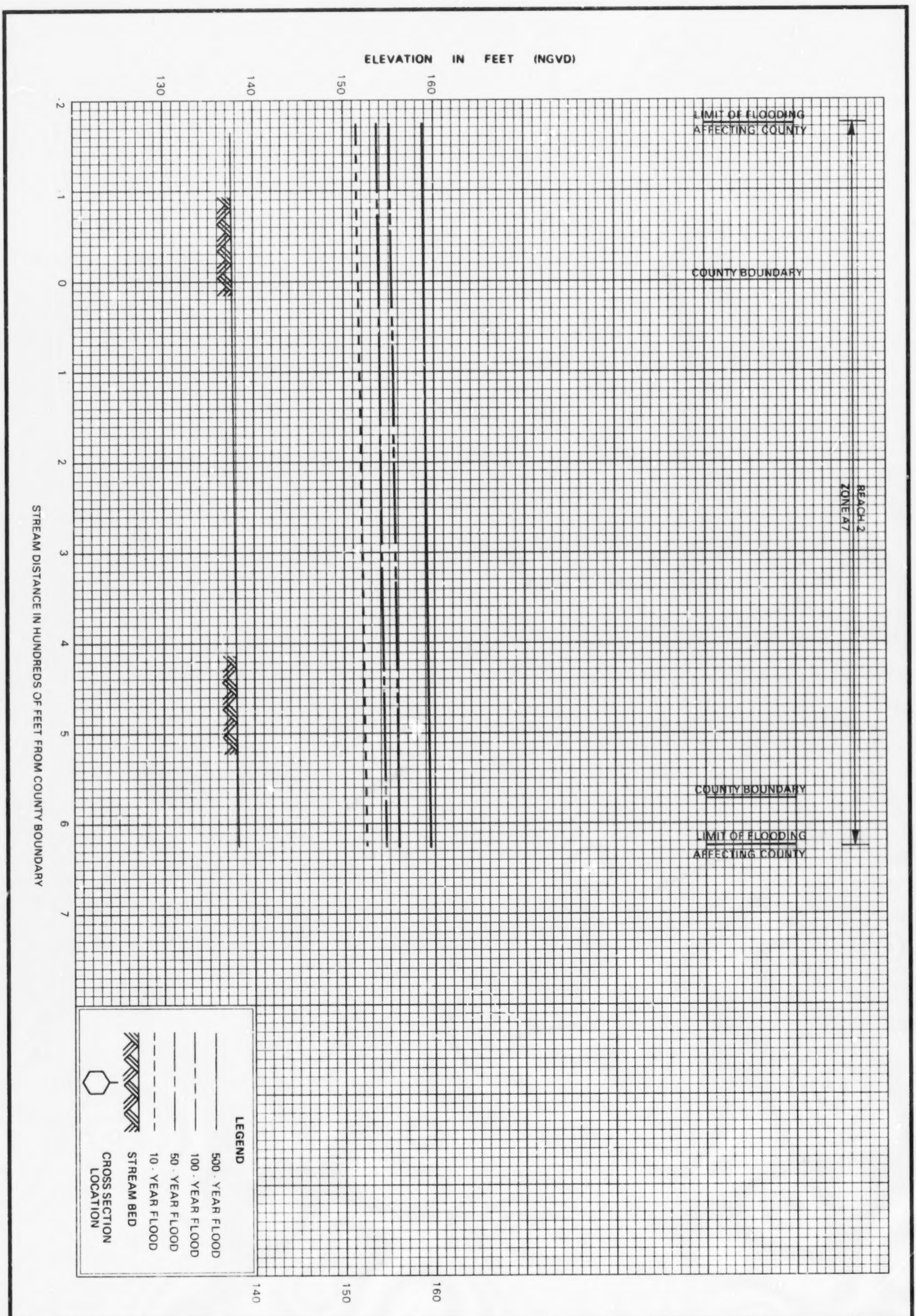

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW CASTLE COUNTY, DE
(UNINCORPORATED AREAS)

FLOOD PROFILES

BRANDYWINE CREEK

46P

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